POPULAR SCIENCE

FOUNDED MONTHLY 1872

NOVEMBER

15 CENTS

20 CENTS IN CANADA

SM

NOW 15¢

RAILROAD FOR OCEAN LINERS . . . Page 43

NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS

55 HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

AN IMPORTANT MEMBER OF YOUR FAMILY

THE telephone is something more than an instrument to carry your voice across the miles. It is a most important member of your family.

Faithfully, constantly, cheerfully it serves you. Keeps you in touch with friends. Stands guardian over your home. Helps to put more pleasure and achievement into life and living. And does it all so capably.

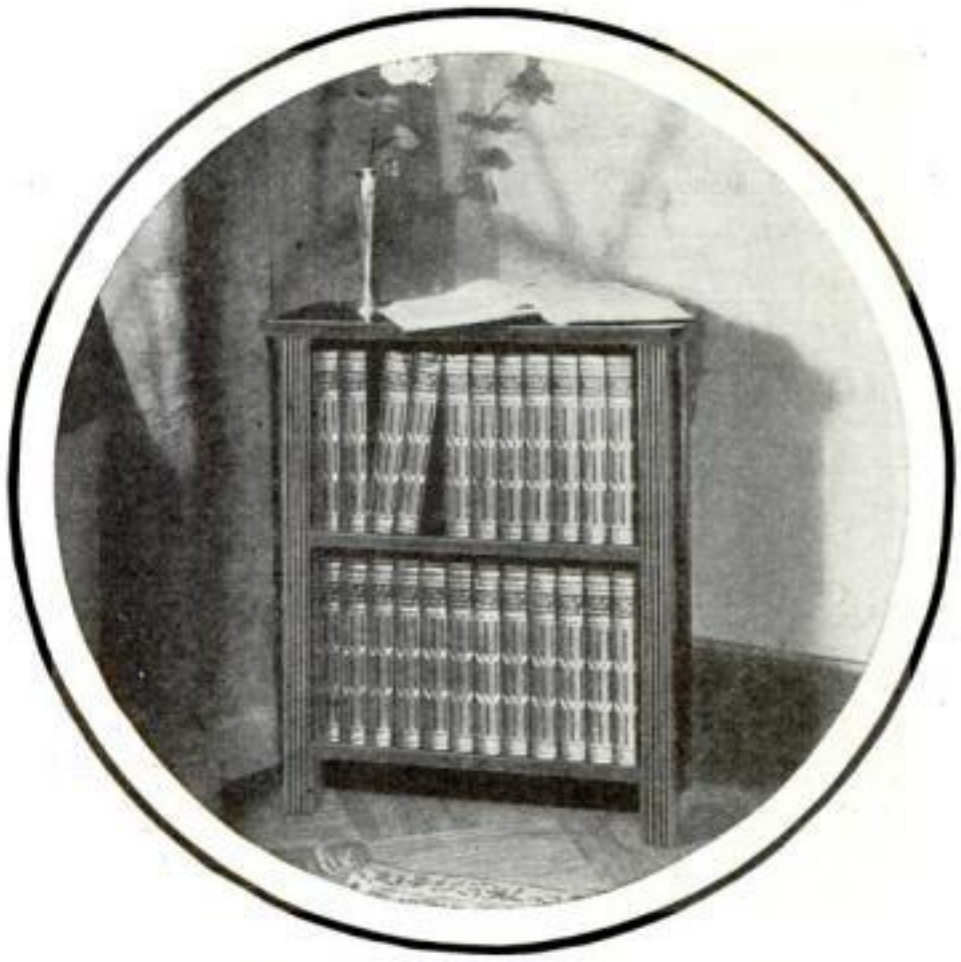
When you are moving, you keep your telephone in the old home until the last van has gone and you place the key in the lock for the final turn. You arrange in advance to have a telephone ready at the new address so there will be no break in your contact with the world. When a young couple starts housekeeping. When there is illness in the home. When somebody goes away. When distances are great. When emergencies arise. On all of these occasions the telephone earns its right to family membership.

Day or night, any part of the telephone company's army of skilled workers, intricate equipment, and millions of miles of wire is at your command.

It is the Bell System's constant endeavor to make the telephone worth more and more to every subscriber.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

useful
dependable
indispensable



The Britannica is the Standard Encyclopaedia of the World

WITHOUT a doubt, the new Britannica, placed where neighbors may see it, lends a tone of quality to your home.

The only reason, however, for owning the new Britannica is its usefulness.

Usefulness is the single test of its value to you. And usefulness is the supreme characteristic of the Fourteenth Edition.

How widely useful is the Britannica cannot be fully expressed in one advertisement, nor in a hundred. Along with the century and a half of service earlier editions of the Britannica have enjoyed, the fact that in every country many sets of the latest Fourteenth Edition continue to be bought each day is striking evidence that people buy the Britannica because they need it.

It is, as thousands of letters declare, the most useful set of books in the world.

The Britannica Is Dependable

To be wise is to know where to get information. The Britannica gives its owners assurance that within reach is about all the information they will ever need.

Owning the Britannica, you are not liable to face new problems with "that sinking feeling." You are supported by the highest living authorities. You are served by the knowledge of 3,500 of the world's leading thinkers and doers.

Mrs. Nellie Taylor Hiley,
Hoquiam, Wash.
"No work like the Encyclopaedia Britannica, anywhere. It is the last word in deciding, and in argument. The last word in educational value. We have gotten our money's worth long ago."

Willis A. Sutton, Former President,
National Education Association
"One of the great virtues of the new Britannica is its unassailably authoritative character."

The Britannica Is Indispensable

"I could not get along without it" are the words of men and women everywhere. This is not surprising once you learn how closely the Britannica enters into your life from day to day.

An item of news needs clarification, a dress needs expert mending, a child is suddenly ill and the doctor delayed, a problem of percentage faces a taxpayer, a conversation requires the accuracy of authority, a contract needs the history of the law, a motor needs mending, a roast is to be carved—one can turn confidently to the Britannica for help and the solution of these and almost every other conceivable human problem.

The new Britannica *is* indispensable to progressive people.

Easy to Own
$5 Down and $5 a Month

Considering its completeness, the quality of its text, illustrations and its authority, the Britannica is the least expensive encyclopaedia you can buy. But for how long it will be available at the present low price no one knows.

The shrewd man is the one who buys today. Our easy payment plan gives you the opportunity of using the Britannica while you are paying for it in small installments. As little as $5 delivers the new Britannica to you.

Send for Free Booklet Now

Send for particulars about the Britannica, the price and easy plan of payments today.

Fill out the coupon and drop it in the mail. We will send you a large booklet *free*. It gives you a cross-section of the Britannica — rich in color plates, maps and sample pages—the low prices and the easy payment plan. *Mail the coupon now.*

FREE

SEND FOR FREE NEW BOOKLET TODAY

ENCYCLOPAEDIA BRITANNICA, INC.
342 Madison Avenue, New York City

Please send me, by return mail, without obligation, your new illustrated booklet with color plates and maps from the latest Britannica, together with low price offer representing a saving of many dollars. 2-P.S.M.-F-2

Name.....

Address.....

City..... *State*.....

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 121 · NUMBER 5
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

Table of Contents for November, 1932

LEADING ARTICLES

FEATURES AND DEPARTMENTS

AUTOMOBILES

AVIATION

ENGINEERING

MODELS

NEW DEVICES FOR THE HOME

(Continued on page 4)

November, 1932, Vol. 121, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1932, by the Popular Science Publishing Co., Inc. Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

The Early Method of Counting
Gave Us Our Word
TALLY

Tally goes back to the time when a count of things was made by cutting notches in a stick of wood. The word is derived from the French *tailler* "to cut" and *taille* "a cutting," "a tally." It was customary, in earlier times, for traders to have two sticks and to mark with a notch on each the number or quantity of goods delivered, the seller keeping one stick and the purchaser the other. When such records came to be kept on paper, the same word was used, and it is now generally applied to various kinds of counts and scores.

Every day you use hundreds of words whose origins are as interesting and surprising as this. You will find their fascinating stories in

WEBSTER'S NEW INTERNATIONAL DICTIONARY
The "Supreme Authority"—The Merriam-Webster

DELIBERATE

"Weighed in the Scales"

A **deliberate** decision is one based upon a weighing of the facts and arguments involved—and that is the literal meaning of the word **deliberate.** It is derived from Latin **deliberatus,** formed from the verb **deliberare** which is a combination of **de,** a prefix denoting "down," and hence "completely," and **librare** "to weigh." **Librare** comes from **libra** "a balance or pair of scales."

INTOXICATE

From "Poisoned Arrows"

The Greek word **toxon** means "arrow." From this was derived the Greek **toxicon** and Latin toxicum "a poison in which arrows were dipped." This was the source of the Latin intoxicare "to drug or poison" and of English **intoxicate.**

The coupon below will bring you free an illustrated booklet of word-origin stories. Not only do these stories make the most interesting reading, but to know them will give you an effectiveness in speaking and writing that can come in no other way. When you know where our words came from, and their essential meanings, as they are presented in The Merriam-Webster, your own use of words will become more forceful, accurate, and colorful.

The Merriam-Webster gives you the whole word power of the English language. In its **3,000 pages** there are **487,000 entries,** including thousands of **new words; 12,000 biographical** entries; **32,000 geographical** subjects; **100** valuable **tables;** over **6,000 illustrations.**

Rely on the testimony of **Presidents** and **Department Heads** of the leading **Universities;** the indorsement of hundreds of **Supreme Court Judges;** the judgment of **Librarians** all over the country who choose the MERRIAM-WEBSTER for their own use.

The Wealth of Information covered in the encyclopedic treatment of words in the Merriam-Webster is really amazing. For example, the word **coin** is defined in twelve lines. But following this definition are **four columns** of information giving the coins of the world, their names, the metal, the native equivalent, and their value in U.S. and British money. In addition, further information is given under the name of each of the important coins, frequently with an illustration. And besides all this there are two full pages in color illustrating the coins of the world. **Architecture** is another example. Under this word there is a full page showing historical styles with examples and structural features and this is supplemented with a very large variety of pictures. There are, in addition, two full-page plates of Architectural Statues and Monuments and Notable Examples of American Architecture.

The Merriam-Webster is a whole library in one volume, its type matter equivalent to a 15-volume encyclopedia.

YOURS
Without Extra Charge
NEW REFERENCE ATLAS of the WORLD

if you take advantage of our special offer in connection with Webster's New International Dictionary. This Atlas is new throughout—new maps, new plates, new index, new binding—and has latest official census figures for all cities and towns of the United States. Size 9¾ x 12½ in. Mail the coupon for offer which gives you this fine Atlas without extra charge.

Send the Coupon for
FREE BOOKLET
"INTERESTING ORIGINS of ENGLISH WORDS"

Without cost or obligation we will send you a most interesting illustrated booklet containing a collection of fascinating stories about the origins of words. Just mail the coupon. We will send also full details of our special offer of the ATLAS without extra charge and information about Webster's New International Dictionary.

Mail This Coupon for FREE Booklet

G. & C. Merriam Co., Dept. S., Springfield, Mass.

Please send me, free of all obligation or expense, your illustrated booklet INTERESTING ORIGINS of ENGLISH WORDS; details of your special ATLAS Gift Offer; and full information about Webster's New International Dictionary.

(P.S.M. 11-32)

Name.....

Address.....

City..... *State*.....

(Continued from page 2)

NEW PROCESSES AND INVENTIONS

PHOTOGRAPHY

RADIO

UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

In This Issue—Hundreds of Articles and Pictures Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

CONSTRUCTION KIT FOR MAKING A BATTLESHIP MODEL AT LOW COST

TO ENCOURAGE you to build our new ship model, the battleship "Texas," described on pages 67, 68, and 69 of this issue, the Popular Science Homecraft Guild is offering a complete construction kit of materials for $6.95, shipped postpaid to any address east of the Mississippi River. To points west of the Mississippi it is necessary to charge 50 cents extra because of the high shipping costs.

The amount of material required to make a model as large and elaborate as this—the hull is 3 ft. long—is surprising. Experienced model makers, most of whom have spent untold hours shopping for hard-to-get supplies, know this, but beginners often have the idea that they can go out and get whatever is necessary in the course of a Saturday afternoon. They quickly discover that the materials used in ship model making are not so easy to obtain, especially in small quantities.

Each kit for making the battleship contains five pieces of soft, straight-grained pine for the hull, ¾ by 6⅜ by 36 in.; all the necessary wood for making the superstructure, turrets, boats, and other parts, each piece being cut to the approximate thickness, width, and length; wooden rods 1/16, ⅛, 3/16, ¼, and 5/16 in. in diameter for masts, guns, searchlights, and the like; sheet brass in three thicknesses; three sizes of brass wire; two sizes of brass rod; ⅜-in. brass tubing for the funnel; brass tubing for the propeller tubes; soft metal and very small chain for the anchors; silk thread; large and small glass beads; nails, pins, and escutcheon pins—in fact, everything required for making an exhibition model except the paints. If a working model is desired, the machinery, of course, must be obtained separately. The kit also includes a complete set of blueprints showing the model full size. Bought separately, they alone cost $1.

If you wish to save yourself the work of marking and sawing out the five main hull pieces or "lifts," these will be cut accurately to shape upon request at an additional charge of 50 cents.

A coupon below is given for your convenience, but if you do not wish to cut the magazine, you may order by writing a separate letter.

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me all the materials (except paints) required for building a 3-ft. exhibition model of the U. S. S. *Texas*, and also Blueprints Nos. 197 to 200.

☐ I inclose $6.95 (or $7.45 if shipment is to be made west of the Mississippi River).

☐ Send C. O. D.

Name.....
(Print name very clearly)
Address .....
City..... State.....

Note: This offer is made only to readers in the United States.

Real Truth About Tobacco Is Important To Pipe Fans

Good Time To Use Hard Common Sense. Real Pipe Pleasure Still Easy To Find. Cost Is Very Low.

As more and more men turn to pipe smoking as a part of their new economy program, there is a rising demand for the plain facts on tobacco quality. These are some of the facts:

Smoking tobacco can be bought for a few cents. Or one can pay as high as several dollars for a few ounces of "special mixtures." The difficulty with buying an inferior or low grade brand is that the smoker fails to get the full pleasure to which he is entitled. "Cheap" tobacco, like an unfaithful friend, soon wears out its welcome and leaves behind it a trail of regrets. The costly brand is an economic mistake, too, because it is possible to get the best there is in smoking tobacco at a reasonable price. For example—a better quality of tobacco cannot be had than the top-of-the-market burley that goes into the famous Edgeworth Smoking Tobacco. The Edgeworth blend is unlike any other. Smokers like the way it is cut. It is made in two forms —"Edgeworth Ready-Rubbed," all ready for the pipe; and "Edgeworth Plug Slice," which is the favorite with pipe smokers who like to rub up each smoke in the palm of the hand. The fine, smooth quality of the tobacco was put there by nature.

Edgeworth Smoking Tobacco has never been known to bite a man's tongue. Smokers who are not acquainted with Edgeworth will find it in the famous blue tin at any tobacco shop anywhere. All sizes from the 15c pocket tin to the pound humidor package. Some sizes come in vacuum sealed tins. Or, those who would like to try it before buying may have a neat little package containing Edgeworth Ready-Rubbed by sending name and address to Larus & Bro. Co., 110 S. 22d St., Richmond, Va. No charge of any kind for this sample smoke.

For radio entertainment that is different listen in to the Corn Cob Pipe Club of Virginia, broadcast over the NBC coast-to-coast Red network every Wednesday evening at 10 o'clock, Eastern Standard Time.

Why Business Men *are beginning to* Smile

By LEON MEADOW, *Financial Editor*

A FEW days before the November Financial Article was scheduled for the press, we received a letter asking for a summary of present financial and business conditions. The writer also wanted to know exactly what had been accomplished by the various relief measures organized to combat the depression, and what, in our opinion, could be expected for the near future.

It would take a very long letter to answer all that, and, furthermore, these are questions that are on everyone's lips today. So we changed our plans for this month's column and took the liberty of publishing our reply in the form of the following article.

• • •

IN THE last few months a great change has taken place in our country's economic and financial affairs. Almost three years of declining business and decreasing security values had made it look as if all traces of previous prosperity had been completely wiped out. Due to the strong momentum of this deflation and due also to financial reversals abroad, all the heroic measures taken to stem the tide seemed practically worthless.

At times it looked as if the United States were headed for a complete breakdown, utter bankruptcy. But it isn't necessary to give the story in complete detail. We all read about, talked about, and knew about the situation as it stood at the beginning of the summer in 1932. And we should know by now that such conditions easily lead to despair and create a state of mind which is in itself highly destructive. Bear this in mind as you read our explanation of the reversal in trend and sentiment which came about in July and August.

FINANCIAL and economic life today is so complex that any large movement (either up or down) is invariably the result of a variety of causes. Yet, in looking for the principle factors which brought about so sharp an improvement in sentiment in these last few months, it would probably be correct to give credit to two sets of circumstances—a natural one and an artificial one. Together, they seem to have mastered the situation. The *natural factor* was the simple fact that there is a limit to any downward movement—just as we learned in the fall of 1929 that there can be a decided limit to an upward trend. Roll a rock off a high mountain top and it may seem irresistible as it gathers speed and rides over everything in its path. And yet, that rock can't go on forever. Somewhere, sometime it will stop or be stopped.

This, economically speaking, was the situation we faced as the first half of the current year neared its end. Production and consumption, transportation and employment, market values of commodities, stocks and bonds—all had dropped to unheard of levels during a period that covered almost three full years. Steel mills were running at one-tenth of plant capacity, rail transportation was back to prewar volume. Commodities were selling for far below their production costs, stock averages represented 10% of their 1929 highs and the bond market was in a totally demoralized condition.

But this, like the rock, couldn't go on forever. With steel plants operating at only 10 to 14% of capacity, it was unreasonable to expect a further decline unless the country were returning to the Stone Age! It was equally unreasonable to assume that agricultural, mining and other products should continue to sell so far below cost. And, in the stock and bond markets, values were simply being given away, as if there were never a chance of any improvement.

HOWEVER—and here we come to the *artificial factor*—when things actually do have the aspect of threatening disaster, the rescue is nearby. In this case, the extreme seriousness of the situation moved our Government to more efforts to support the weakening structure of our banking and credit systems. Even more heroic steps were taken to instill life into our commodity and security markets. Our governmental system, by the very nature of its structure, is slow to move, even during times of economic depression. But once it becomes clear that real danger is present, a sense of patriotism, above party interests, has always prevailed. This is what can and, in this case, did ultimately lead to swift and effective measures. Credit must be given to the co-operation of our two leading political parties. They made possible in the "nick" of time the passage of a number of laws which were extremely helpful in avoiding pitfalls that awaited our fight against economic and financial recession. Private business—in particular, our banks—added strength to the movement by organizing support for the security markets.

The Glass-Steagall Law (P. S. M., June '32, p. 4) was one of the first constructive measures aimed at, and successful in re-

ducing the number of bank failures and in protecting the gold standard. Then came the Reconstruction Finance Corporation, formed to take over and broaden out the operations of the old National Credit Corporation. The latter had a capital of half a billion dollars, subscribed for by private banks. For the new organization, the Government appropriated half a billion dollars also, and besides gave it the power to issue debentures up to $1,500,000,000—guaranteed as to principal and interest by the Government. In this way an enormous amount of capital was available for making loans to banks, insurance companies, building and loan associations, mortgage and finance corporations, Federal Land Banks, agricultural credit corporations, etc. An amount of $50,000,000 was immediately turned over to the Department of Agriculture for the purpose of making loans to farmers.

AMONG the last acts passed by Congress before it adjourned was the so-called Relief Bill, permitting the Reconstruction Finance Corporation to raise $1,800,000,000 by the sale of debentures. $1,500,000,000 of this was to be used for making loans to states and cities for productive works, while the other $300,000,000 was to be set aside for unemployment relief work.

Other measures included the empowering of the Federal Banks to lend capital to corporations and individuals directly under certain conditions and the appropriation of $322,000,000 to be spent by the Government for public construction work. Recently, the new Home Loan Bank Bill was put into operation by the formation of 12 Home Loan Banks, principally intended to relieve the mortgage situation, but also in a position to render financial aid in the construction of new homes and apartment houses. A sixty day moratorium, postponing mortgage debt foreclosures, was ordered to give corporations and individuals a respite should distress hit them before the aid offered by these new Home Loan Banks became available. And last—but not least—there are the steps taken toward balancing the Federal Budget. This removed the uncertainty which for a long time had threatened to upset our financial structure almost beyond repair.

Among private measures, the $100,000,000 "bond pool" organized by leading banks must be mentioned. Also, there is the formation of the Commodities Finance Corporation, designed to remove the threat of huge commodity surplusses overhanging the market.

These gigantic artificial stimulants were administered at practically the same moment at which business and security values touched bottom. They suddenly and unexpectedly brought about the realization that a serious collapse had been averted. Public sentiment changed from despair to hope. At first moving slowly, this improvement gained momentum and surprised the world by its increasing strength. The first sign was an improvement in the market price for hogs—and it was soon followed by an improvement affecting many other commodities.

The banking situation was also greatly relieved, failures became rare. Confidence in country banks *(Continued on page 8)*

WHY BUSINESS MEN ARE BEGINNING TO SMILE

(Continued from page 7)

was restored, for now, provided they were actually solvent, they could receive aid from the Government. Many receiverships of large railroads and utility companies were avoided. The rise in commodity prices rekindled hope among farmers, manufacturers, and retailers. All these factors reflected themselves quite naturally in the security markets, causing stock averages to rise at an almost unequalled pace, and regaining for bonds an average of 40% of the level to which they had fallen.

Cattle prices rose from 6.15¢ per pound in May to 8.20¢ in August; hogs from 3.45¢ to 4.30¢; cotton from 5.25¢ to 7.34¢; Sugar from 2.58¢ to 3.15¢ in this same period. During the last part of August wool, silk, copper, rubber, cocoa and many other commodities moved upward. The market value of representative industrial stocks almost doubled, and that of railroad stocks more than tripled. The rise in bond averages has been given above.

And now, to answer the second question of the letter that prompted this article, we must first ask and answer another question. What is the practical value of all these signs, indications, artificial reliefs and organizations? Toward what do they point?

FOR one thing, its value lies in the return of confidence and hope in the public mind; the realization that in our mood of despair and pessimism we had lost all sense of intrinsic value; the firm conviction that, after all, our country is not lost, but can look ahead to better times. The practical value lies, therefore, in a correction of mistaken opinions, in the restoration of a common sense view of the situation. Partly, it is also an expression of the expectation that we have all awaited —namely, .that we have now actually begun an upward trend. A rise in commodity prices and security quotations, such as recently took place, has often been the signal for the end of previous depressions. For this reason the fact that business in general has not improved as yet should not necessarily be taken as evidence that the current improvement in markets is unfounded. But a well meant warning to avoid exaggeration before definite proof *is there*, is not out of place. By now, all of us should have learned the dangers of overdiscounting and exaggeration, and it will certainly be better to go slowly and surely than to rush and be sorry. Nothing would be more pitiful than to have this welcome improvement abused to such an extent by false enthusiasm that a serious reaction would be inevitable. All the good work done at so great a cost and effort would only be destroyed, and then this country would certainly face an even harder task in rebuilding from such a collapse.

What must not be forgotten or allowed to slip the mind for a minute is the fact that recovery from three years of depression is bound to be slow. It cannot be accomplished over *(Continued on page 9)*

WHY BUSINESS MEN ARE BEGINNING TO SMILE

(Continued from page 8)

night. The rebuilding of national purchasing power will of course be gradual; business volume, feeling its way in the dark, can only increase little by little. Many adjustments are still to be made, and they will have to be made in an orderly fashion. Very likely, unemployment will be with us for some time, although it is to be hoped that a steady reduction of it will take place.

In the light of all this, it is not very wise to anticipate a rapid revival. On the other hand, even a conservative attitude warrants a much more hopeful outlook than that which seemed ahead of us three months ago. This nation can breathe again with a well earned sigh of relief. We are still on firm ground, and ahead of us is the hard, but not impossible task of rebuilding for normal, good times on a sounder and more lasting basis than the flimsy speculative structure that the 1929 prosperity proved to be.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worthwhile investment as well as a form of protection. Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate Plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

Awards valued at

$75,000

ENROLL NOW!

Every boy in the United States and Canada, between the ages of 12 and 19 years, is eligible

Join the Fisher Body Craftsman's Guild! . . . Associate yourself with live, ambitious boys throughout the United States and Canada. . . . Take part in a test of skill that gives you every chance to win recognition and earn substantial awards for work well done.

More than 2,000 awards have already been distributed among Guild members. *All* the contestants have gained invaluable experience—formed lasting friendships—learned much that will help them toward success through all their lives to come.

The Third Annual Guild Competition is now getting under way, and you can enter without paying a cent in fees or dues. Just follow the simple instructions on the opposite page.

Boys who took part in the 1931 or 1932 competition can also enter this one, but they must enroll again to be eligible to compete.

Where else have you ever seen or heard of such an opportunity? It's knocking on your door now *for the third time.* Why don't you do something about it?

These boys earned $5,000 Scholarships this year

GORDON DRUMMOND (S)
936 Quincy St., NW.
Washington, D. C.

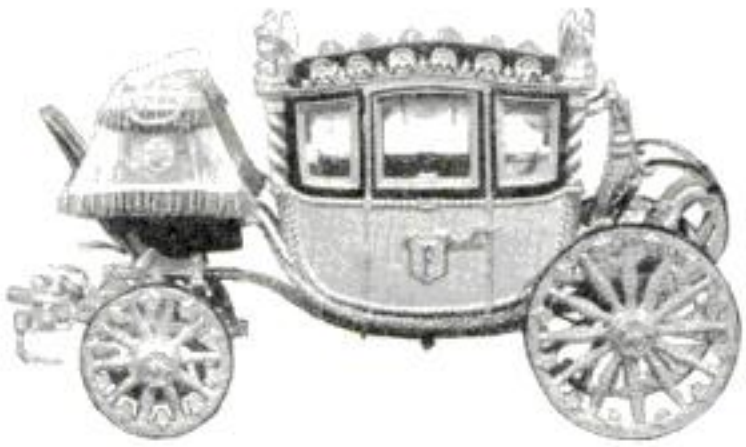
FRANZ IBISCH (S)
Newcombe St.
Columbus, Wis.

FRED FRIEDRICH (J)
277 Lexington Ave.
Rochester, N. Y.

RAYMOND SMITH (J)
801 B Avenue
Lawton, Okla.

FISHER BODY

Another big opportunity!



Four University Scholarships . . . 112 trips to Chicago's "Century of Progress" Exposition . . . 1120 other valuable awards

A complete college education in return for proof of outstanding skill! That's how four Guild boys are going to be rewarded.

A royal time at the Guild convention in Chicago, where that long-heralded "Century of Progress" Exposition will be in full swing! Such is the award awaiting 112 boys who earn first Senior and Junior honors.

And there are 1120 Gold Awards, 20 for each of the United States, and 20 for each Guild District in Canada. In all, Guild members will receive awards valued at $75,000!

Conditions of the 1933 Guild competition are the same as those which governed the two previous competitions. The judges are men of highest standing in the knowledge of craftsmanship. At their head as Honorary President is Daniel Carter Beard, National Boy Scout Commissioner. Honorary President of the Canadian Section is John A. Stiles, Dominion Commissioner for Scouting.

Join the Guild. Enter the competition. It may be your big chance to get started on a successful career! Read the simple instructions below—fill out the coupon—and enroll today!

How to Enroll in the Guild

It's easy to become a Guild member. Just go to any dealer in General Motors cars (Cadillac-LaSalle, Buick, Oldsmobile, Pontiac, Chevrolet) and say you want to join. He will do the rest. Your Manual Training teacher also can take your application—or the local Boy Scout Leader. Or you can simply fill out the coupon at the right and mail it to Guild Headquarters. Shortly after enrolling you will receive your membership card, an official Guild button and complete information about the Guild craftsmanship competition for 1933.

Fisher Body Craftsman's Guild Enrollment Coupon

(Please print plainly in all spaces below)

Boy's Name_____

Enrolled before ☐ Yes ☐ No

Born_____ day of_____ (MONTH) (YEAR)

Address_____

City_____ State_____

Name of your School_____

Grade_____

Manual Training Teacher_____

Principal_____

Be sure to mail this coupon at once to the Fisher Body Craftsman's Guild, General Motors Building, Detroit, Mich.

E

CRAFTSMAN'S GUILD

Our Readers Say

Cheap Sunshine Requested for Oklahoma Winter

Now is the time for someone to write an article for your magazine showing how to rig up at home a unit that will enable us "sun starved" people to enjoy the Mazda Sunshine Bulb next winter with no more expense than the cost of the bulb, scrap materials, and a little time. We poor folks can't afford even the least expensive "sunshine" unit and stand. But we want our sunshine. We are hungry for it! The cheapest complete outfit is around $30. The bulb is only about $3.75. Why should the unit (the voltage reducer, the transformer, or whatever it is) cost so much? I pretend to be broad-minded enough not to say that an article on the lamp unit should take the place of such-and-such an article, because nothing is so nearly perfect as to please all your readers. Now if this "broad-minded" letter gets into "Our Readers Say," I suppose your cartoonist will depict me sunning my large head with an ultra-violet lamp. If it gets in, I wish you would first have an English composition professor and an electrical expert rewrite it so I'll be protected from the mud that some readers are always ready to sling!—W. S., McAlester, Okla.

After All, Tools Are Needed To Build a Good Boat

I'M A fairly new reader, but already getting the fan spirit about your Workshop Department. Being a rank amateur when it comes to building things, I'd like to raise a little point in connection with your blueprint articles. When you tell us how to make a boat or canoe, for example, and give a list of materials needed, why don't you also tell us what tools are needed for the job? I'd like to have an idea how much I'll have to spend for tools I may not have for some particular project I'd like to make.—H.M., Carmel, N. Y.

Are You a Hero—and Why? Don't All Answer at Once

HERE'S one for some psychological shark suggested by your "Robot Hero and Fire Panic" article in the October issue. I've known a flock of heroes—I'm not one of them—and as far as I could see each was first cousin to a jellyfish: splendidly stupid and not a thrilling nerve in his body. They merely went into the hero business because they didn't know enough to keep out of it. I'm not referring to police officers and firemen, who are paid to be heroes, but to the common and garden variety—the amateur hero. Am I right? You bet your life and I am. For a pleasant companion and friend, give me a cheerful coward every time.—J.F., Dallas, Texas.

When the Moon Comes Over the Orange Belt, Calif.

I THINK G.D.W. of Lansing, Mich., is wrong in his explanation of "Full Moon and Frost." In the first place, dew does not fall. It condenses on the ground or on the foliage of plants. Therefore, the gravitational force of the moon would have no affect upon the dew "falling." As to the heat of the moonlight we receive, I would suggest that G.D.W. get a good book on astronomy, and find out the exact amount of heat the earth receives from the moon. Here, in the Orange Belt, of California, much orchard heating is done and any grower will tell R.L.R., Worden, Ill., that the moon has no effect upon frost. Frost and temperatures down to ten or twelve degrees below freezing are controlled by the amount of water vapor in the air, or the dew point. Clouds and gentle winds also help to control the affect of the frost, and a warm day preceeding the frost will lessen the damage.—H.P.C., Tustin, Calif.

If You Don't Know This One You Can Ask Your Cat

I SUPPOSE that some, if not all, of the readers of this page know why cats always land on their feet. I have heard it attributed to everything from accident to divine interference, and consequently I did some research work to determine the facts. I will tell you the result, and I should like to see what others think about it, if anything. A cat swings its tail around like a crank when falling. Its body, of course, is revolved in the opposite direction, for action equals reaction. If a cat is dropped back down, with the feet turned slightly off vertical, the tail will be swung in one direction. But if the feet are off vertical in the opposite direction, the tail will swing the other way around. Now what puzzles me is whether the cat will always swing in either the clockwise or counter-clockwise direction if the feet are perfectly vertical when dropped. We might then find that some cats are clockwise cats, and some are counter-clockwise cats. I haven't a sufficient number of cats at my disposal to justify me in making a generalization. Airships might be stabilized in like manner.—D.A.B., Detroit, Mich.

Splitting the Atom Holds Future of the World

YOUR articles on chemistry by Raymond B. Wailes hit the spot with many of us. It is my belief, though, that they are too elementary in character. I think something a little more technical would be appreciated by those of your readers who have taken high school chemistry and wish to continue study in that field of science. I am waiting for an article on the transmutation of elements and the progress that has been made in that line of science in the last year. I believe that the future of the world is tied up in the "atom splitting activities" of modern science.—B.W., Vienna, S. D.

Here's a Mean Little Question for the Class in Evolution

MANY letters on "Our Readers Say" pages have been devoted to evolution. Pro and con. Here's an interesting fact these evolution hounds might ponder: The "gall fly," a little wasp that makes swellings on oak leaves, dates back to the time when three-toed horses still ranged the western part of the United States, according to Arnold D. Hoffman, University of Chicago research worker. Between two layers of shale, Hoffman found the impression of a prehistoric oak leaf with swellings closely resembling those on modern leaves. The wasps lay their eggs in the tissues of the leaves to insure abundant food for their young grubs. Where does this fit in with your evolution?—J.E.M., Yonkers, N. Y.

Little Balls, Big Balls All Keep Rolling Along

THE problem in a recent issue of POPULAR SCIENCE MONTHLY submitted by P.C., concerning the two bowling balls, can be answered by saying that both the largest and the smallest balls will require the same time to make the trip. The time that it will take either ball to reach the goal depends only on the starting or initial velocity and the acceleration given to it. In each case the initial velocity is zero because they both start from rest. The acceleration of each is due to gravity and is therefore the same. Thus the time of each ball is the same. It will be seen therefore that the size of the balls does not affect the time of their arrival at the destination.—R.J.B., Milwaukee, Wisc.

Here's a Hiccough Remedy That Will Kill or Cure

WHAT the situation is down in your part of the world, I wouldn't know; but out here where men are men, there is an epidemic of hiccoughs. Make your own guess as to the cause. In a stubborn case, a good home remedy is the following: The sufferer holds an ordinary paper bag so that its open end tightly covers his nose and mouth, excluding all outside air, and breathes in and out of it. This results in an accumulation of carbon dioxide gas in the bag. Breathing such a mixture has often

halted severe cases of hiccoughs. No harm is done as long as the treatment is stopped before the patient faints or dies or asks for another quick one.—E.LeR., Prescott, Ariz.

Maybe This Reader Has No Real Love for Dogs

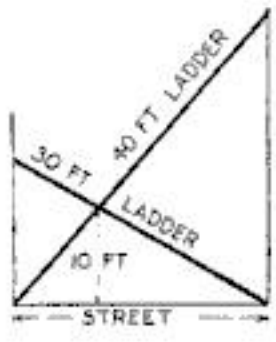
THIS dog business is rather getting on my nerves and I thought I'd just mention the fact to you. Civilized, city dwelling people have as much need of a dog as a high powered auto has for a horse. I see that over in Hungary compulsory vaccination of dogs is being tried out in an effort to stamp out hydrophobia. Once a year, all dogs, more than three months old, are to be given injections of anti-rabies serum. The cost of the injections will be borne by the state. Wouldn't it be a better idea to vaccinate the people against any desire to have the worthless beasts around? Noise, dirt, and fleas—that's a dog. Plus a weak minded sentiment, prehistoric in origin and atavistic in survival.—R.G., New York.

Blood Fell Like Rain But— Where Were the Feathers?

I'VE done a great deal of reading on the subject of weird, natural phenomena such as the fall of fish from the sky, reported in your article "It Does Rain Fish" in a recent issue of POPULAR SCIENCE MONTHLY, and I'm not satisfied with the so-called scientific explanations given for these occurrences. Here's another one for you. Some time ago, in the nineteenth century, a red liquid fell for several hours over the city of Rome. Taken to the city health laboratory, it was analyzed as being composed of the same type of corpuscular structure common to human or animal blood. The scientific explanation given and accepted was that some flock of birds, traveling at a very high altitude, had run into a local hurricane of enough strength to tear the weaker and younger birds to pieces. Hence the fall of blood. Fine—as far as it goes. But if you accept that explanation, why did blood, and only blood, fall? Why was there no report of feathers, of bones, of flesh also falling? How would you explain it? Or does anyone think it likely this blood-like rain came from warring factions engaged on Mars or Venus? —A.G., Lowell, Mass.

Leaning Ladders Give You the Width of This Street

THIS is my first time in print and I am provoked into it now by G.N.P., of Meriden, Conn., who has asked for a mathematical chestnut. Here it is: Two ladders are leaning across a street. The street runs north and south. One ladder leans from the east side at the juncture of the building and side walk, and reaches over to the building on the other side. This ladder is forty feet long. The other ladder is thirty feet long and starts on the west side of the street at the juncture of the building and side walk and reaches over to the other side. At the point where the two ladders intersect it is ten feet to the pavement. The buildings are perpendicular. How far is it from one building to the other? You have the best magazine of its kind on the market.—P.E.F., Huntington, Ind.



Brother's Age Is Anything from Three to Eighteen

L.D.L., Pottsville, Pa., wants to know how old the boy, whom we will name John, is? We will name his brother, Bill. Now there is no solution to this problem. John could be the youngest and he could be three years old; six years old, nine years old, twelve, fifteen, or even eighteen years old. He could be three, nine years before Bill was one, now ten, or he could be six, nine years before Bill was two, now eleven. So, Mr. L.D.L., I am not going to tell you how old John is. —F.C.C.C., Flint, Texas.

Our Baby Planet Nothing to Get Haughty About

YOUR mention, in a recent issue, of a new baby planet reminds me of one I have seen twice with the naked eye right here in Perth Amboy, N. J. I saw it first in November, 1919. Three years later I again saw it in October. Being astronomically inclined, I often look at the moon. Imagine my astonishment at seeing what I thought was a toy balloon passing across the moon. However, I soon saw it could not be a balloon as it took about three minutes to cross the moon. Possibly this little planet has been known for a long time, but anyway I thought it worth mentioning.—G.R.C., Perth Amboy, N. J.

Airplanes Keep on Flying But They Don't Tell How

W.E.T. certainly are appropriate initials for the bird in Harrisburg, Pa., whose letter appears in a recent issue of POPULAR SCIENCE MONTHLY. He is all wet. He claims an airplane gets its thrust from a partial vacuum in front of the propeller which is supposed to pull the plane through the air. Any high school student knows that vacuums don't pull. What actually happens is that the propeller takes air from in front and piles it up behind, thus making a great difference in pressure on either side. The excess pressure behind pushes the plane ahead. Also it is my pet theory that the inertia of the air has something to do with it. From a complete standstill, the air is suddenly accelerated backward by the propeller. Thus the propeller is shoved ahead not only by the difference in pressure but also by interia. As for the sailboat that's all hooey, too. The wind merely piles up behind the sail, raising the pressure and forcing the boat ahead.—M.C.W.Jr., Cortland, N. Y.

Where Popular Science Leads, The Others Follow Along

I BECAME acquainted with POPULAR SCIENCE MONTHLY about twelve years ago and have been a regular reader ever since. I shall continue to be one, too, for the pages of your magazine put me at least one jump ahead of everybody I know in knowledge of what is going on in the world. It has always been a source of wonder to me how you find so many interesting, new things to describe month after month and how you manage to get them first. Take just a few outstanding developments. POPULAR SCIENCE had a comprehensive and flourishing radio department long before radio broadcasting caught on with the public. Your readers knew all about the mechanics of talking pictures before a single talkie had been shown in a commercial theater. Readers of POPULAR SCIENCE did not need to wait for the epochal Lindbergh flight to make them air conscious. Your magazine had kept them in pace with aviation progress for years before that. When I saw the first newspaper article about the seadrome it was old stuff to me because its inventor had told POPULAR SCIENCE all about it a couple of years earlier. You printed articles on balloon tires, four-wheel brakes, and other automobile improvements before anybody but the automotive engineers had them on their cars. You have been ahead of the parade with everything from the Einstein Theory and cosmic rays to stratosphere aviation, television, and ship models. Keep it up, POPULAR SCIENCE, and more power to your sharp eyes!—A.O.R., Dubuque, Iowa.

Of Course, the Cows Might Give You the Answer

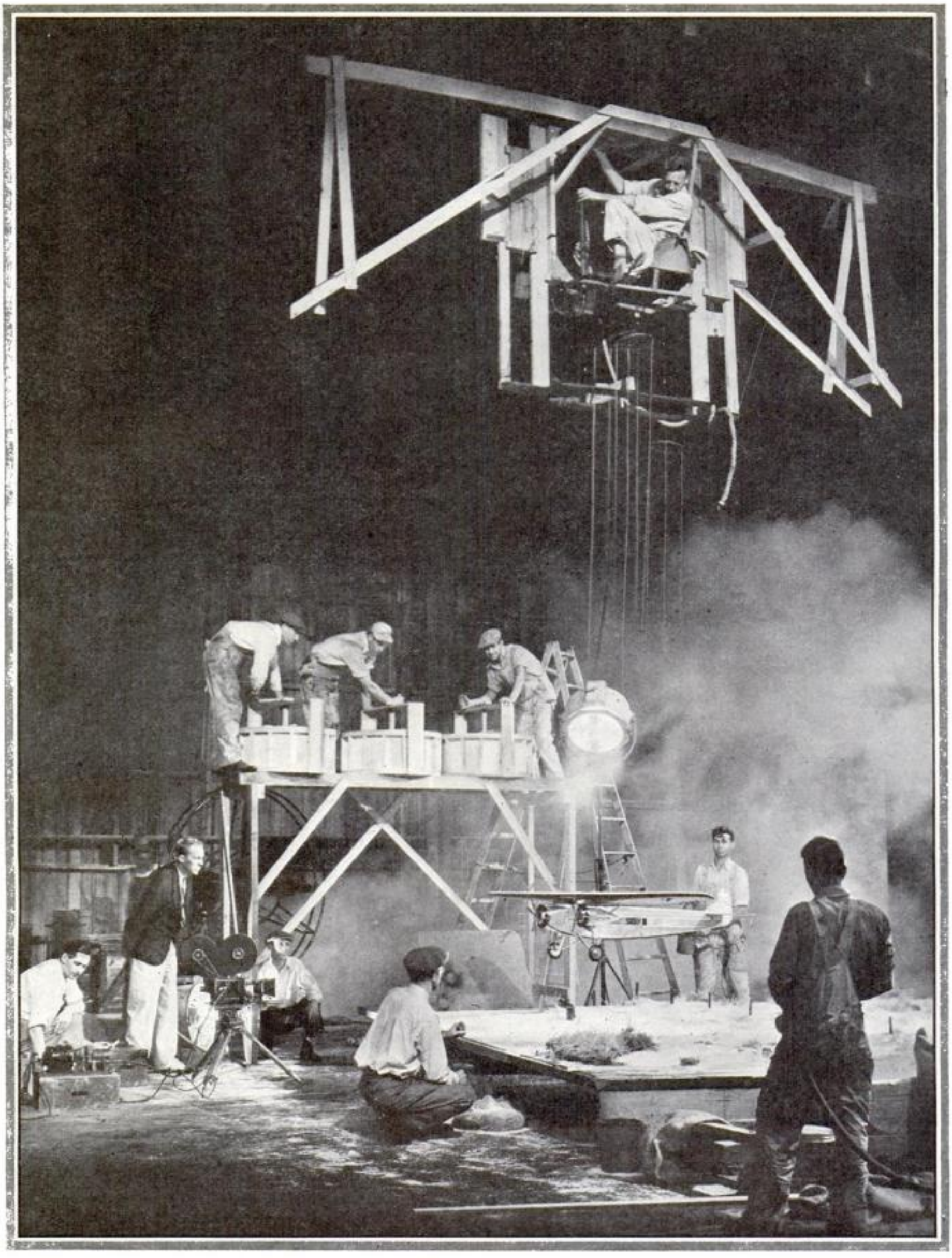
CAN any of your bright and shining readers explain this one: A professor at Ohio State University, finds that a green grass diet for cows produces richer milk than one of dry fodder. His experiments, he says, were conducted over a period of several years. He compared the milk given by cows grazing in the open fields and those fed on fodder and the vitamin content of the latter was found far inferior. I assume the professor is right, but why? What is there in the green grass that isn't in the cured fodder? I'm a dairyman, and I'd like a simple answer to a hard question. —J.B.H., Bedford, N. Y.

Massachusetts Now Claims America's Crookedest River

IN A recent issue of POPULAR SCIENCE MONTHLY there is an article entitled "America's Crookedest River is Mapped." The illustration does not give the whole river, but what is evidently the crookedest part, stating it runs twenty miles to advance only six. Here in Massachusetts we have a river that beats it. The Charles River is claimed by our people to be the crookedest river in the country, and here are some of the figures to prove it! Total length, 85.76 miles. Air line, 25.80 miles. Across Wellesley neck, air line, 3.49 miles. Around by river, 23.05 miles. Dedham, or Long Ditch, 0.74 miles. Around by river, 6.16 miles. Another interesting feature of this crooked river, is that at Dedham, it loses one third of its water via Mother Brook, to the Neponset River. In its *total length* it is as crooked as the selected part of Nolin River, and in places, it is crookeder.—D.W.N., Wellesley Hills, Mass.

Grandpa's "Jolly Rocker" Makes Three Sets of Twins Happy

I BOUGHT a copy of your April number and was very much interested in the "Jolly Rocker." I begged some discarded wheels, took them apart, and used the felloes. Since then I have made and given away six "Jolly Rockers" at a very small expense. The funny part is I have given them to three sets of twins. They were boys aged about six, nine, and eleven. The "Jolly Rocker" is a great joy producer, fits any age, and with discarded wheels lying around everywhere one can use scrap lumber, nails, and perspiration and set Rockers a rocking. That is my experience and I am only eighty-two.—A.E.W., Newark, N. Y.



Puppet Planes for Tragic Scenes

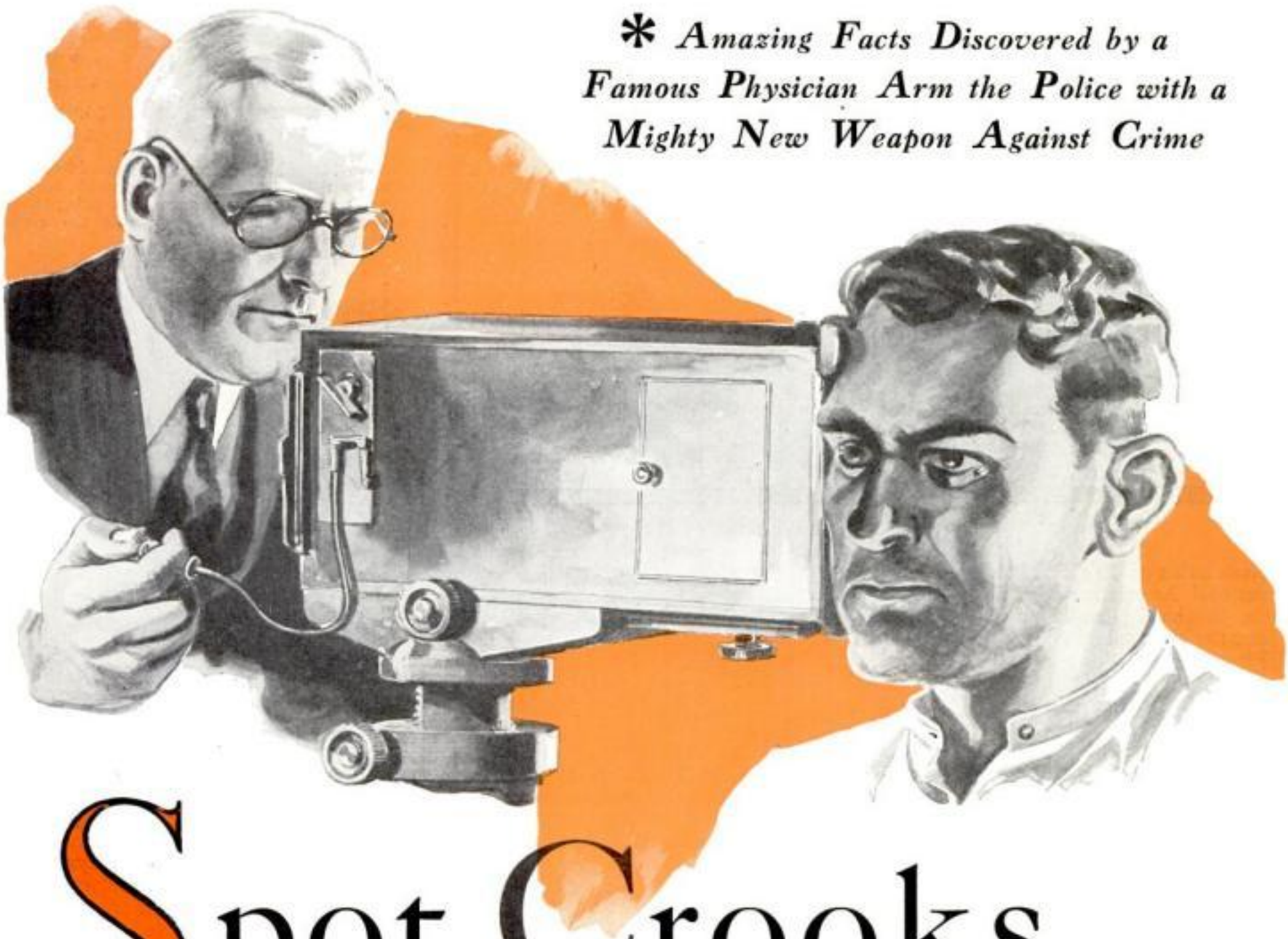
Skill in the use of toy planes has added new thrills to the movies without endangering the lives of actors. Suspended in air and worked by many invisible strings, the little planes go through their amazing stunts while the cameras grind, and no realistic detail is lacking to the startling scene. *See page eighteen for full description*

POPULAR SCIENCE
MONTHLY

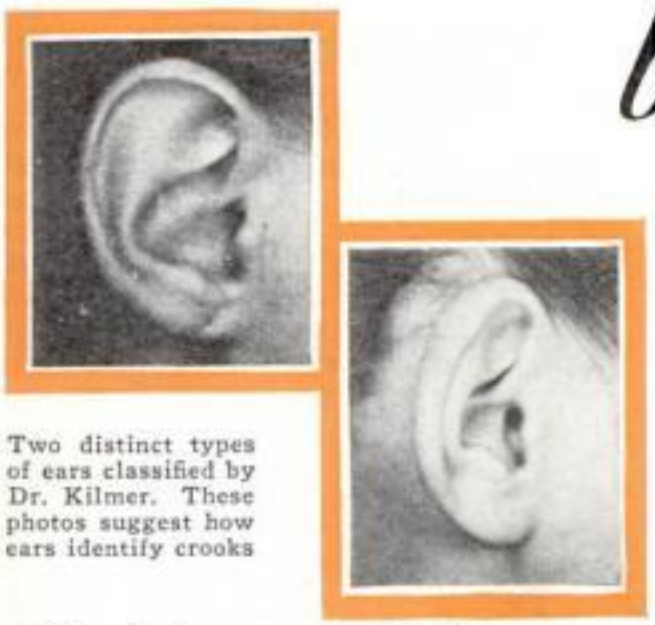
November 1932 Vol. 121, No. 5

RAYMOND J. BROWN, *Editor*

* *Amazing Facts Discovered by a Famous Physician Arm the Police with a Mighty New Weapon Against Crime*



Spot Crooks *by their* EARS



Two distinct types of ears classified by Dr. Kilmer. These photos suggest how ears identify crooks

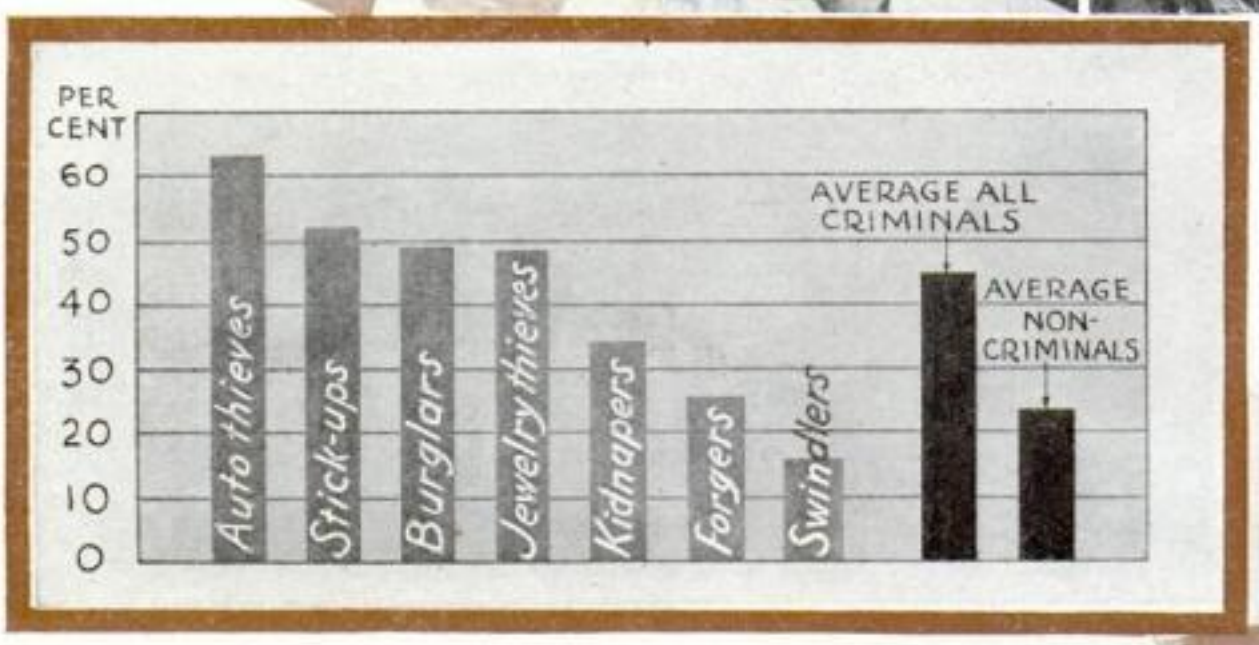
By EDWIN TEALE

A TEN-YEAR search for two ears just alike has led to the discovery of a new weapon against crime.

The other day, Dr. Theron W. Kilmer, noted New York physician, told police officials at the seventh annual convention of the National Identification Association, meeting in New York City, of discovering a "criminal ear" that appears twice as often among gangsters, thieves, and thugs as among honest citizens.

In addition, he has worked out a system of classifying ears as an aid to trailing wanted men. Because of his researches, such strange terms as "flap ears," "earographs," and "one-o'clock ears" may soon hold important places in the vocabularies of American detectives.

For when Dr. Kilmer speaks, police officials sit up and take notice. His studies in connection with the life-saving and identification branches of police work have brought him honorary memberships in such organizations as the New York State



CRIMINAL BRAINS DON'T GO WITH FLAP EARS

Above, from left to right, two types of flap ears, and close-set ears. At left, chart shows how percentage of flap ears varies according to the intelligence required to commit the crime

Association of Chiefs of Police, the International Association of Chiefs of Police, the National Identification Association, and the National Association of Police and Fire Surgeons. For many years a lecturer for the New York City Board of Education and the New York City Police Department, he is widely known as a criminologist and identification expert.

A strange little dialogue with himself, some ten years ago, played an important part in starting Dr. Kilmer on his study of ears. One day, he was looking over rogues' gallery photographs at police headquarters and picked up a side view.

"This," he mused to himself, "is Mike Mulligan. How do I know it is Mike Mulligan? Well, it looks like him. If I take away this ear does it still look like him? Not so much. Well, suppose I take away Mike Mulligan and leave the ear, can I still recognize him?"

He decided to find out. He began to study ears, compare ears, photograph ears, seeking to discover whether every ear is as distinctive as the license plate on a motor car or whether two or more ears are often identical.

On the street, in church, on subways, he noted the sizes and shapes and styles of the ears around him. He grew to recognize hundreds of unknown people by their ears. Dinner guests at his home became used to the invitation: "Now, let's get a picture of your ears!" as they retired from the table. Year after year, he photographed the ears of his family, his patients, his friends.

Incidentally, among his other accomplishments, Dr. Kilmer is an expert photographer. One room of his home is fitted up with all the equipment necessary for portrait photography. A few years ago, this hobby of his received unusual recognition when a monthly publication dealing with the work of portrait photographers devoted a whole issue to his pictures. He was the first amateur so honored.

To get scientifically exact ear pictures, he had to develop a special camera for the purpose. At first, he tried fingerprint cameras but they were unsatisfactory. Finally, he constructed a black oblong box, fourteen inches in length and five inches square. It contains a three-inch lens located so it throws an image on the plate which is exactly the size of the ear being photographed to the fraction of a millimeter.

Within this oblong box, three tubular, 110-volt electric light bulbs flash on for the fraction of a second when a picture is snapped to provide the necessary illumination. The four by five inch window in the front of the camera is placed against the head of the person whose ear is being photographed so the ear is in the center of the picture. As the camera is always placed in the same position in relation to the head, the picture is always taken from the same angle.

To test the accuracy of his apparatus, Dr. Kilmer photographed various patterns of wallpaper, placing the negatives over the originals to see that they matched in every particular. On half a dozen different days, he took pictures of his son's right ear. Tests later revealed that these six negatives were identical. No matter when or where the pictures are made, the "earograph" camera records the same ear exactly the same.

Photographs made in San Francisco, Calif., and in Portland, Maine, if the person is the same, will coincide absolutely and establish identity beyond a doubt. However, when different ears, that appear identical to the naked eye, are photographed and the negatives placed one on top of the other, differences instantly stand out that set them apart. In making his pictures, Dr. Kilmer always photographs the right ear. This coincides with the ones shown in the center of standardized side views of the rogues' gallery.

In all, Dr. Kilmer told me, he has photographed and compared upwards of 3,000 different ears. And no two, in all that number, were alike. More than that, he found that the right and left ears on the same head are always different, contrary to long-held opinion. The more pictures he took, the more sure he was that he was on the trail of a new means of accurate identification.

While "earographs" are not expected to supplant fingerprinting as a final check upon identity, Dr. Kilmer does foresee their wide use as an additional test to supplement fingerprinting. A criminal seeking to escape arrest can disguise his features in many ways. He can dye his hair, thin out his eyebrows, grow a beard to cover his face, wear heavy glasses that hide his eyes. But, since the ear becomes useless if it is covered, criminals practically never attempt to disguise it.

A detective who has the picture of a wanted criminal's ear in mind is helped to pick out his man no matter how he is otherwise disguised. And an ear can be studied without arousing the suspicion of the one under observation.

I remember one famous New York detective who told me that he made most of his captures of wanted men by recognizing the backs of their heads. He didn't know why it was easy for him to remember people he saw in police lineup that way, but he knew it was. Inasmuch as the ears are one of the most prominent features of a head seen from the rear, this detective was probably unconsciously making use of Dr. Kilmer's plan of identification by ears. In Paris, as an aid to French detectives, the rogues' gallery contains rear views of the heads of criminals as well as front and side views.

If Dr. Kilmer's discoveries are applied by criminologists, the chattering teletypes and police radios of the future may broadcast descriptions of fleeing criminals that contain some such sentence as this:

"*Watch for this ear:* Flap, Lobeless, Eleven-O'Clock, Round, Shut."

Those cryptic words will mean much to the detective trained in the ear classifications worked out by Dr. Kilmer. There are five divisions.

In the first, the ears are divided according to their position on the head as seen from the front. "Close" ears are those that lie comparatively flat against the head; "flap" ears those that stick out. The second division contains the "lobeless" ears, ones growing right out of the skin above the angle of the jaw, and "lobe" ears, having the familiar fatty appendage at the bottom.

The third division denotes the manner in which the ear is attached to the head, that is, whether it is straight up and down, tilted forward or tilted back. The axis of the right ear is compared to the hour hand on the face of a clock. If the ear is straight up and down, it is designated as a "twelve-o'clock ear." If the top is farther ahead than the bottom, so the ear appears tilting forward, it is called a "one-o'clock ear," and if it tilts back, it is an "eleven-o'clock ear."

The general shape of the ear, either "round" or "elliptical," forms the fourth division. The fifth designates whether the canal, or opening, of the ear is visible in a side view. In "open" ears, the canal is visible; in "shut" ones, it can not be seen.

By broadcasting such information, the search for a wanted man is instantly narrowed down. Just as an officer on the lookout for a stolen car with an Indiana license plate ignores all machines with other plates, so the detective searching for a criminal will eliminate all suspects with entirely different ears, thus saving time and avoiding the arrest of innocent persons. And, while an auto-thief can change his license plates, a criminal can't change his ears to disguise himself.

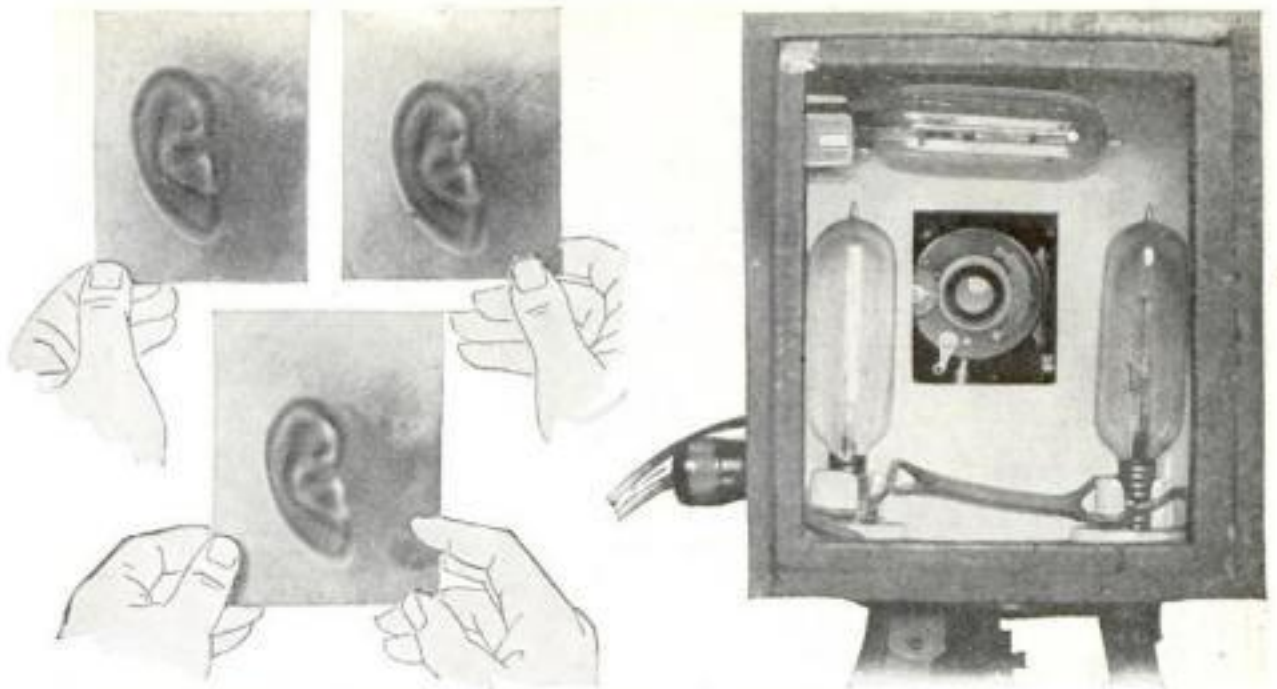
The chances of an innocent person having ears that tally in all five respects with those of a wanted criminal are slight. Even then, the exact negatives of the "earograph" camera would expose the differences between them.

It is often impossible, in the work of identification, to get a good look at a person's face. Again, he may be sitting down so an estimate of his height and weight will be difficult. But one glimpse of an ear may settle his identity. By means of this clue alone, a sleuth can often pick his man from a throng of people.

Besides aiding in the capture of criminals, Dr. Kilmer believes his researches will help in identifying victims of violence and missing persons and may also play an important part in kidnaping cases. His tests have shown, he told me, that the human ear changes little from childhood to old age. He has compared pictures of children's ears with the same ears later in life. During his decade of research, he has repeatedly examined and photographed the same ears and found they remained identical year after year. Thus, a person kidnapped in childhood and recovered years afterwards, might be identified by his ears.

Families, he also learned, have similar ear traits that show relationship to the eyes of the expert. In addition, his investigations have exploded the old theory that an ear without a lobe indicates degeneracy. There is no basis in fact, he told me, for this belief.

A few years ago, a bullet-riddled body was found on the outskirts of Chicago. It was thought by the police to be that of Frank Foster, notorious gangster then wanted in connection with the "Jake" Lingle slaying. *(Continued on page 105)*



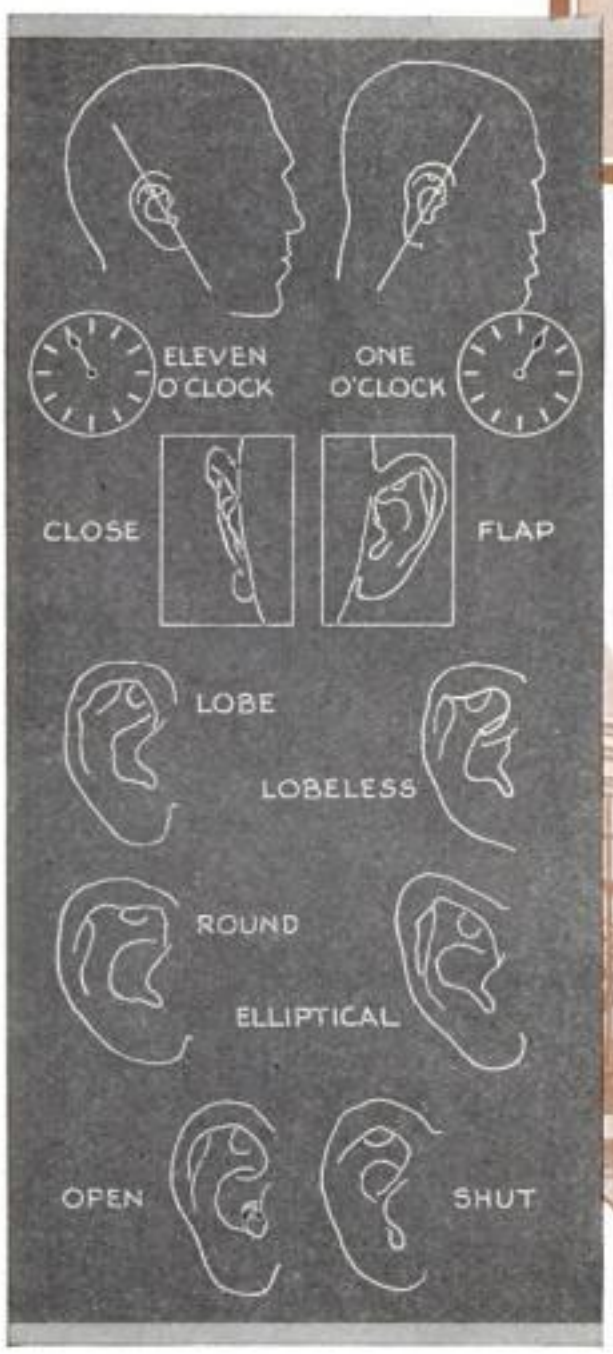
At right the interior of the earograph camera. Left, two photos of the same ear and below them, picture showing how the two negatives coincide when one is laid on top of the other

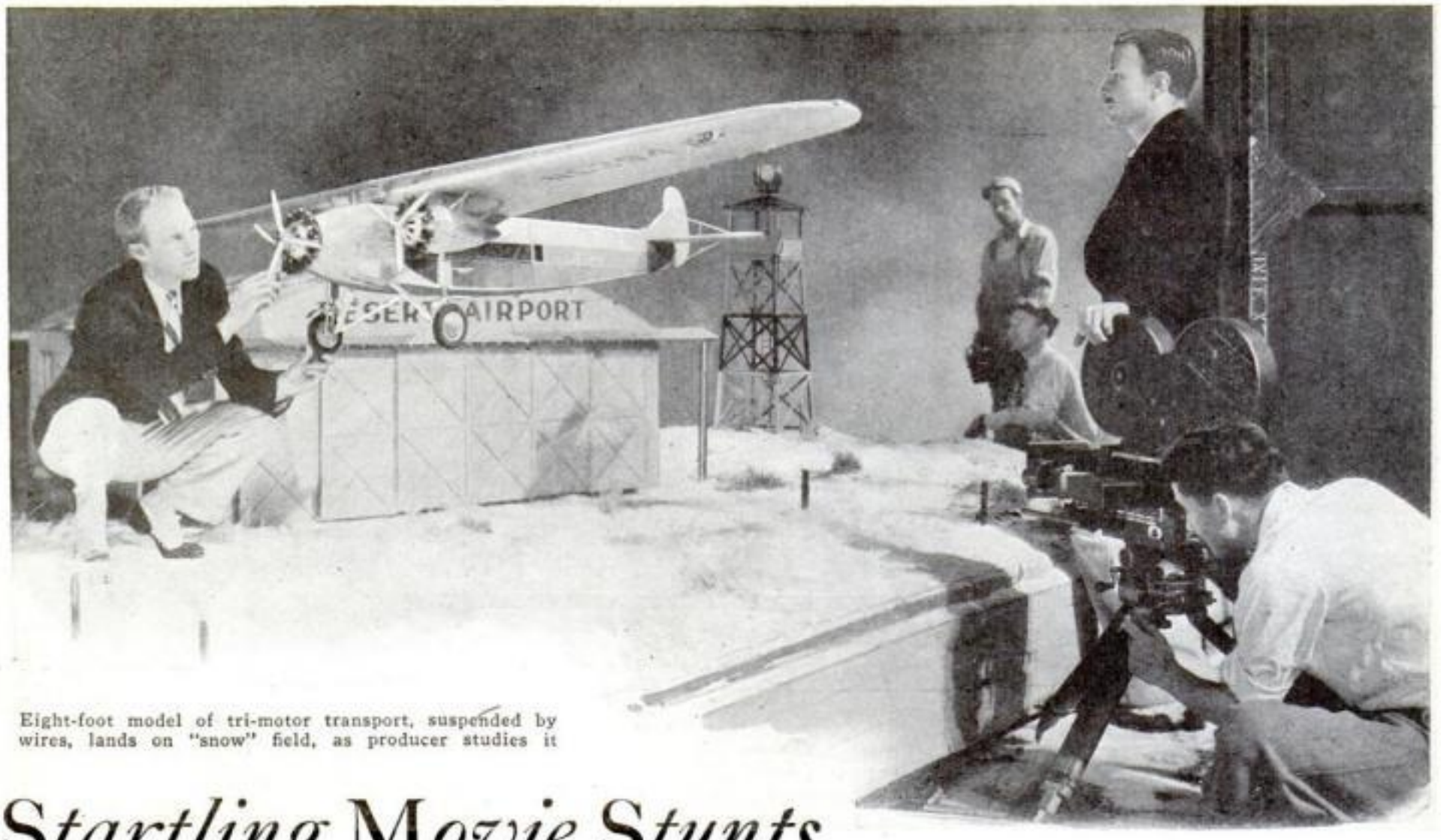
FIRST FULL PRESENTATION OF NEW IDENTIFICATION SYSTEM

AS WE go to press, Dr. Theron W. Kilmer is telling the National Identification Association, meeting in New York City, the startling fact that he has discovered a "criminal ear." For over thirty-five years, Dr. Kilmer has been a prominent physician of New York City while his work in criminology has won him honorary distinction in Europe and America. It is thus a matter of great pride that POPULAR SCIENCE MONTHLY is able to give its readers the first complete report of the work done by this famous physician and student of human nature.

WHAT TIME IS YOUR EAR?

The drawings below give you a clear idea of the various types of ears and will enable you to pick your type





Eight-foot model of tri-motor transport, suspended by wires, lands on "snow" field, as producer studies it

Startling Movie Stunts with Toy Planes *on* Strings

By ANDREW R. BOONE

PUPPET airplanes, looking exactly like full-sized machines ready to fly, now take the place of real planes in filming movie air stunts. On great sound stages, they are always under control, ready to "fly" through fog and storm and snow or to be photographed against mountain and cloud backgrounds for thrilling closeups in the air.

Whether tiny or large, the planes are suspended by wires and cables operated by a "pilot" who sits high above the stage in a discarded airplane seat, one hand resting on a conventional control stick with which he dips the plane, lowers the tail for landings, and otherwise manipulates the top plane as though a pilot were flying it free from outside control.

Thrilling evolutions are performed by these puppets. They dive on a tiny field covered with snow-like gypsum, crash through hangars, explode and burn more realistically than full-sized ships could be crashed by stunt pilots. And they're always under absolute control, ready to do the director's bidding.

Recently I was privileged to witness the making of nerve-tingling scenes at Universal City, while "Air Mail" was in preparation. One full-sized plane actually crashed on a "snow" covered set on the back of the lot; another hung from the roof of a dark stage and was rocked gently by a carpenter standing at one wing as two actors fought "in the air"; other miniature planes, having a wing spread no greater than eight feet, roared down through a storm to land, bouncing, on a snow-covered airport as three property men cranked bleached corn flakes down from as many hoppers and two wind machines blew this "snow" in a wild flurry across the airport.

Many technical problems are involved in making these scenes. A full day may be spent taking and retaking a single scene showing a tri-motored transport gliding through a storm for a landing on the raised platform that looks like a desert landing field. Out of the lot John Fulton, who makes these special effects, may get a single thirty-foot sequence that can be used in the finished picture.

Fully a dozen times during one morning recently, while I sat on a tool box behind Fulton's squat camera, pointed from near the floor up over the "field"

SLIDES DOWN A WIRE TO PERFECT LANDING

This little plane makes a perfect landing in the "snow" because it is gliding down a wire run through screw eyes in its fuselage. At right, with a miniature mountain as a background, the tiny plane tailspins to a thrilling crash that perfectly simulates the real thing without endangering the life of the daring actor-pilot or technician

Dummy Plane *with* Dummy Pilot Pictured *in* Realistic Crash

CRASHING A MOVIE PLANE

Poised on a roof-high platform, right, the dummy plane is ready to crash in front of the cameras. In it, in place of the pilot, is the dummy figure seen above. As the plane drops from the platform, it lands on the exact spot covered by the cameras and, below, it is seen as it strikes with the dummy catapulting from wrecked cockpit

Photos taken especially for POPULAR SCIENCE MONTHLY *by Universal Pictures*

toward the incoming plane, this technical director filmed the miniature ship as it came over at various altitudes and speeds, darting through fog that filled one end of the curtained room, sliding down through the snow, and whizzing past our ears to the end of the 200-foot runway.

Suspended from fifteen tiny and invisible wires, connected in groups of three with his controls sixteen feet above, the little ship looked like a giant airliner dipping through the gloom. Possibly you can get the picture better if I carry you with us through one sequence.

Perched in his chair in a complicated wooden framework attached to a monorail running the length of the sound stage, one of the stage hands quietly awaits the order to "come through." One hand rests on the control stick, connected with thwart-ship and fore-and-aft wooden bars from which the plane is suspended. By moving his hand to the right, the right wing is depressed. By pulling the stick back, the tail settles and the plane prepares to land. And, since the entire framework is counterbalanced, the operator lowers the plane by pulling down on a large rope hanging alongside.

Little mounds of salt and gypsum dotted the fifteen-foot airport; a barbed wire fence, perhaps three inches high, marked the far boundary; from a tiny tin barrel, hardly larger than an ink bottle, flames leaped and black smoke trailed away toward the roof. Brilliant sun arcs cast eerie shadows across the airport.

From the heights came a voice: "How do you want the 'props' to turn, John?"

"Better idle them for the landing," Fulton replied.

The assistant flipped a switch, connected through the tiny wires to motors turning the propellers. Through the shadows I could see them flashing.

"All switches on," shouted the assistant.

"Give us some clouds," Fulton demanded. Two workmen, carrying pots resembling blow torches connected with compressed air hoses, waved the pots around the room between the camera and the plane. As the room filled with tiny globules of liquid clouds, the workmen ducked out of sight.

"Okey," Fulton exclaimed. "Now start the snow."

The whirring wind machines began to blow the corn flakes across the set. There before our eyes a snow storm whipped the lonely port as the single oil barrel invited the troubled air liner down to safety. Everything was ready for the plane to land.

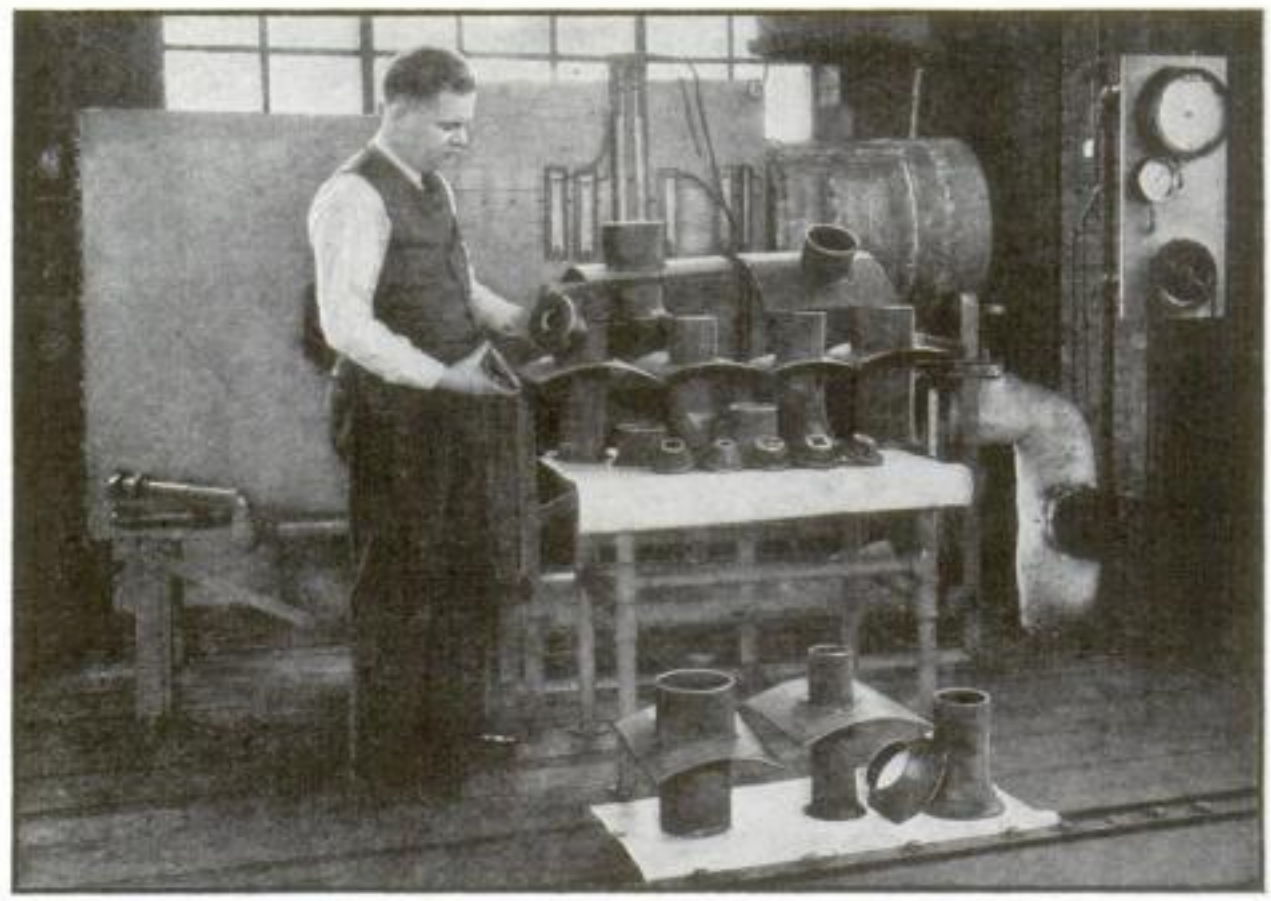
"Let 'er come," Fulton shouted, as he bent down to peer through the finder at the puppet plane.

The plane, moving slowly at first, quickly gathered speed until it sped down the stage thirty miles an hour. An endless steel cable, wrapped around a steel drum turned by electric motor, pulled the plane and its controlling apparatus along. Any of 210 speeds, from one-seventh mile to thirty miles an hour, are available, merely through a turn of a switch.

I have seen many great liners of the air settle on hard runways at night. Never, though, have I seen a landing more realistic than the noiseless glide of the eight-foot miniature. When it started, possibly a hundred feet from the little airport, I could see its running and landing lights poking their way through the man-made storm. Gradually the plane itself took shape and finally, as it sped over the port in a first try at the field, the profiles of pasteboard figures were etched against tiny lights within the cabin. All these things the camera saw and recorded more faithfully than it could a similar landing in a real storm of a plane ten times as large as this one. *(Continued on page 106)*

USE MODEL OF BIG LOCOMOTIVE TO SOLVE RAILWAY PROBLEMS

To SOLVE railroading problems, engineers of the University of Illinois have set up in their laboratory an imitation locomotive. This unusual model is a quarter-size reproduction of the front end of a heavy Mikado-type locomotive, that puffs like a real engine but never goes anywhere. An observation peephole enables the experimenters to see what goes on inside the model. In one series of tests, the efficiency of 186 different shapes of smokestacks was compared, and accurate data have been obtained. Instruments make record of steam flow and atmospheric conditions.



Imitation locomotive, in background, used in laboratory tests of smokestacks

Lights automatically glow behind the map, below, to indicate location of station from which radio program is being received

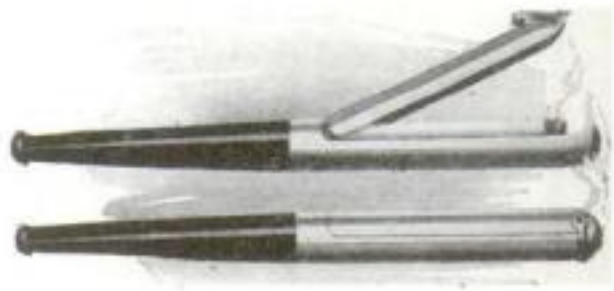
RADIO LIGHT GIVES PROGRAM SOURCE

A RADIO set that shows at a glance the source of a broadcast program is the invention of a young Milwaukee, Wisc., electrical engineer. On top of the set is mounted an illuminated map of the United States. When the user of the set tunes in a station, a lamp bulb automatically flashes behind the map at the point where the program originates. Thus it is unnecessary to wait for the station announcement to learn what station is being heard, a fact that would save much time when a particular station is sought. Lamps are provided upon the map for the majority of the country's important broadcasting stations. Except for this unusual attachment, the set, in outward appearance, resembles a standard instrument and is tuned with a single knob.

MACHINE STEAMS PAPER FROM WALLS

This machine supplies steam that removes old wallpaper

OLD wallpaper is removed in a jiffy by a new portable machine designed especially for the purpose. Its oil burner generates low-pressure steam, which is applied to the paper through a hand applicator. The steam softens the adhesive and the paper peels off. According to the inventor, one man with the machine can finish two or three twelve-by-fourteen-foot rooms in a day. The device may also be used for drying out a room to aid in painting. An attachment is provided to wash water color ceiling.

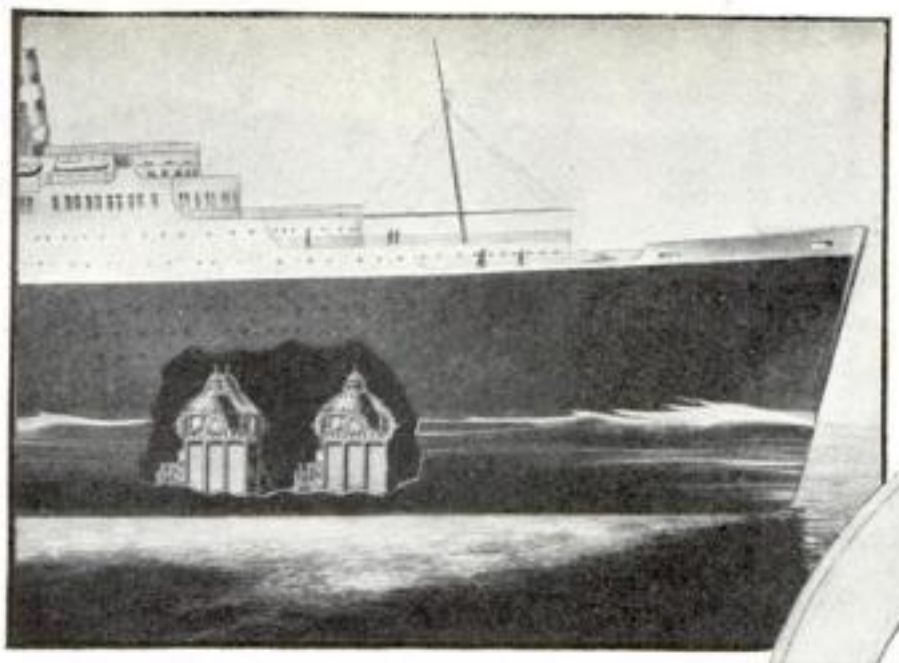


NEW HOLDER ENCLOSES ENTIRE CIGARETTE

SPARKS and ashes cannot flick from the end of a lighted cigarette when it is enclosed in a new safety cigarette holder, pictured above open and closed. According to the New York inventor, it should prove especially useful to motorists. While being smoked, the cigarette is completely enclosed by a folding shell that admits air through perforations. The lighted cigarette may even be placed in the pocket.

OWL CLOCK'S EYES TELL TIME

OWL-SHAPED, with revolving eyes that tell the time, is an amusing clock made in Germany. Hours are read at the left, as you face the owl, and minutes at the right. Thus, in the photograph, the eyes indicate that it is three o'clock. No numbers are on the dials, as one mentally associates the numbers with the proper spacings.



Cutaway drawing of Italian liner showing how the gyroscopes were istalled in hull, aft of bridge

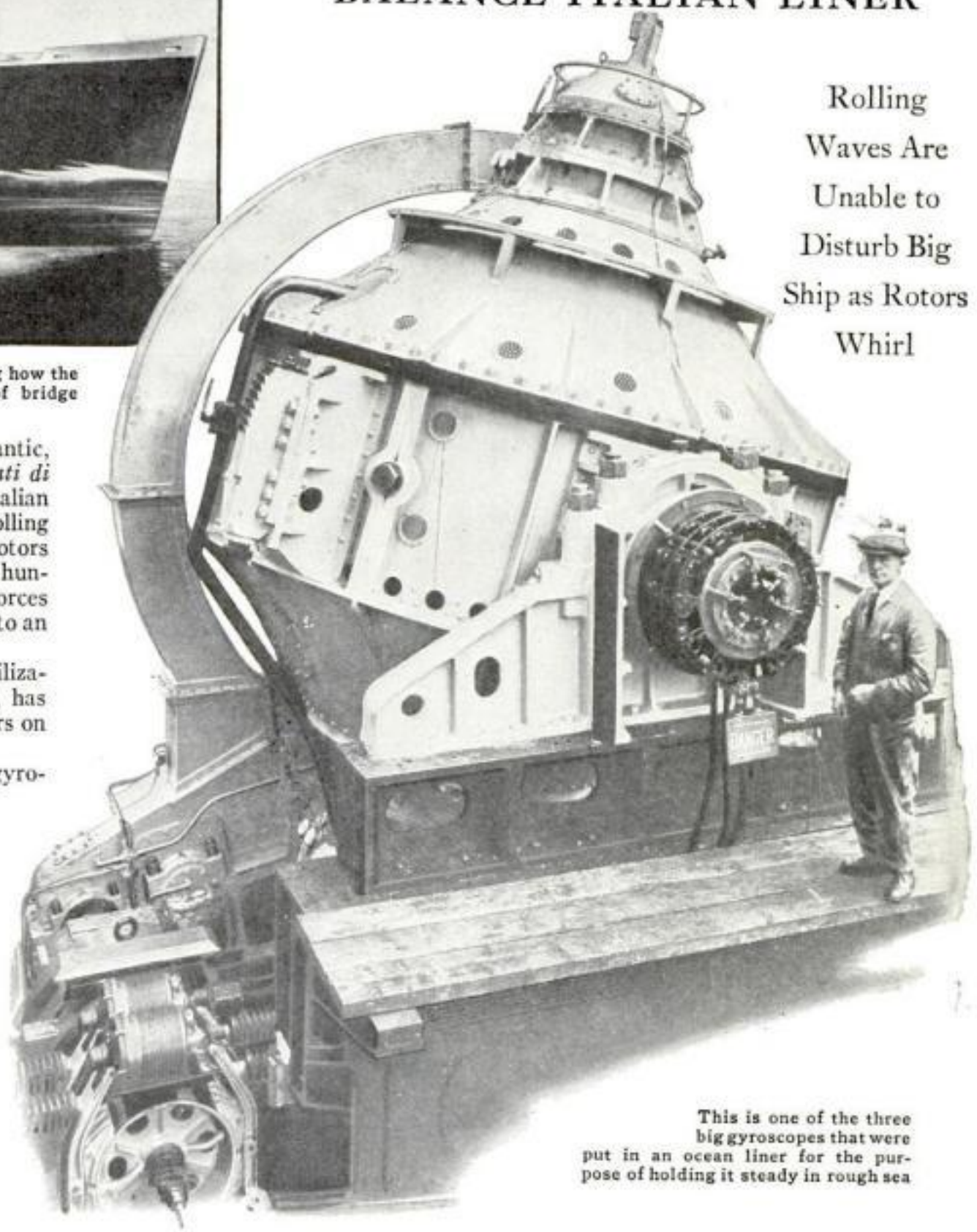
New Gyroscopes
BALANCE ITALIAN LINER

Rolling Waves Are Unable to Disturb Big Ship as Rotors Whirl

SPEEDING across the North Atlantic, near the end of November, the *Conti di Savoia,* newest and second largest Italian luxury liner, will pay little heed to the rolling of the sea. Three giant gyroscopes, with rotors thirteen feet in diameter and weighing a hundred tons, will counteract the disturbing forces of the waves, holding the 48,000 ton ship to an even keel.

For the first time in history, gyro-stabilization, long used on warships and yachts, has been applied for the comfort of passengers on a giant ocean liner.

In operation, a small, sensitive pilot gyroscope detects the first keeling impulse of a wave, and through relays and a geared precession motor, causes the stabilizing gyros to begin tilting, in a fore or aft direction, from the vertical. As long as they are tilting, the gyroscopes counteract the force of the waves.



This is one of the three big gyroscopes that were put in an ocean liner for the purpose of holding it steady in rough sea

MIDGET POST OFFICE HAS PHONE BOOTH

COMBINATION post offices and phone booths are now the style in England. At the compact booth illustrated, in Birmingham, a person may obtain stamps, mail a letter, or make a telephone call to any point in the country. The booths are being erected at convenient locations on the city streets.

PARIS CAFE GIVES DINERS "AIRSHIP" RIDE

Patrons of this Paris café get the thrills of a transatlantic air trip as they sit in a reproduction of an airship while the scenery moves

TO GIVE its patrons some of the thrills of a transatlantic air voyage, a Paris café has installed a reproduction of an airship and control cabin in its dining room. The controls operate a moving panorama on the wall, whose changing scenery provides the illusion that the onlooker is traveling from Paris to New York. The trip takes fifteen minutes. Waiters and other employes in the restaurant are appropriately dressed as stewards, complete with their buttons and gold braid.

NEW FILM WILL PICK UP FINGERPRINTS

Transferring a fingerprint, left, to celluloid film by a new process that police officials approve. Below, resulting record is convenient to handle, practically indestructible, and preserves minute details that might easily be lost

Photos, Courtesy Milwaukee Public Museum

FINGERPRINTS literally are lifted off objects near the scene of a crime, in a new process invented by Alton K. Fisher, assistant in anthropology at the Milwaukee, Wisc., Public Museum. Speedy and accurate, the new method may supplant photographing the tell-tale prints. Police officials hail it as an outstanding advance in criminology which will prove of great assistance.

Specially-prepared films of celluloid, 1/1,000th of an inch thick, are employed. Just before use, a sheet is sprayed on one side with amyl acetate, or "banana oil," which dissolves the surface layer. The dissolved side is then pressed against the fingerprint, which has been dusted with lampblack or aluminum powder. After drying ten minutes, the film may be peeled off. It takes the print with it, so thoroughly incorporated in the film that not even a trace is left on the original object. The resulting film record is convenient to handle and virtually indestructible.

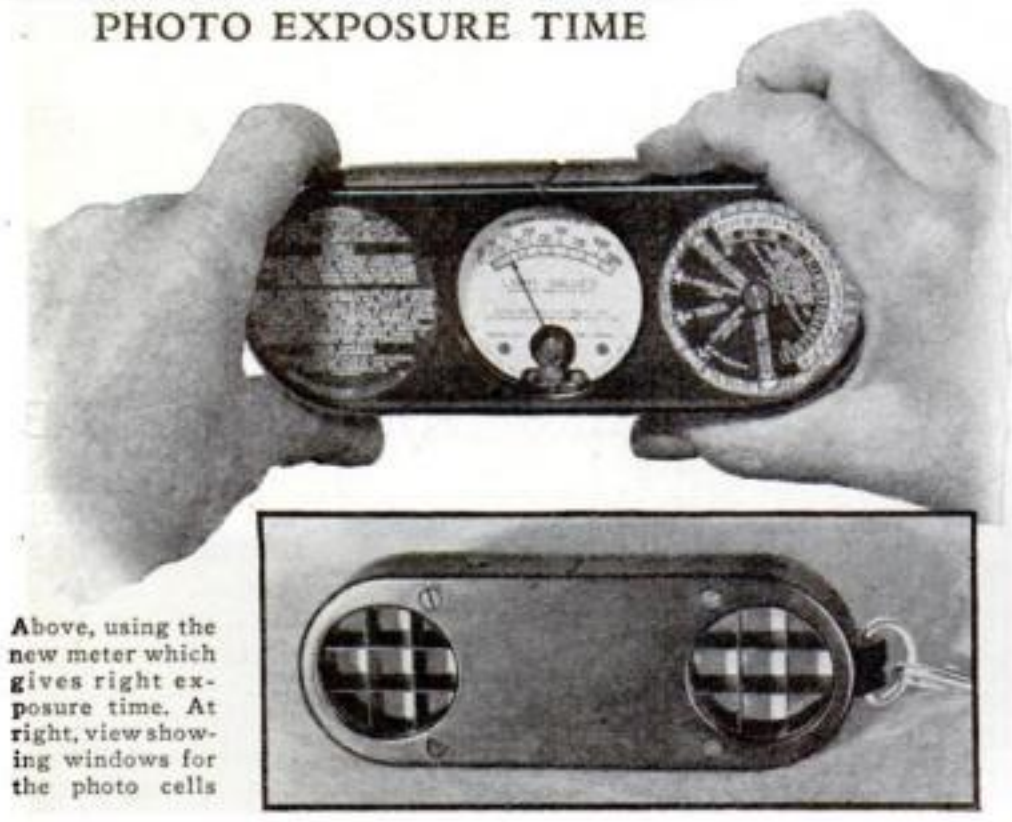
SAFE TRAY FOR SMOKERS

FORGOTTEN cigarettes can do no damage when they are left lying in a new glass ash tray. A close-fitting groove in each rest puts out the cigarette before it burns down far enough to fall off the tray and mar a table top or upholstery.

BOTH ENDS OF LIFEBOAT RELEASED AT SAME TIME

A NEW releasing mechanism for lifeboats was successfully demonstrated in New York the other day. The device was invented by H. J. Ferguson, First Officer of the S. S. *Duchess of Atholl,* to avert danger of capsizing at the moment that the boat casts loose. When the lifeboat reaches the water, a pull of a lever releases fore and aft davit cables simultaneously. A connecting rod, which runs along the bottom of the boat, operates both releases at once and virtually makes an accident impossible.

ELECTRIC EYE GIVES CORRECT PHOTO EXPOSURE TIME



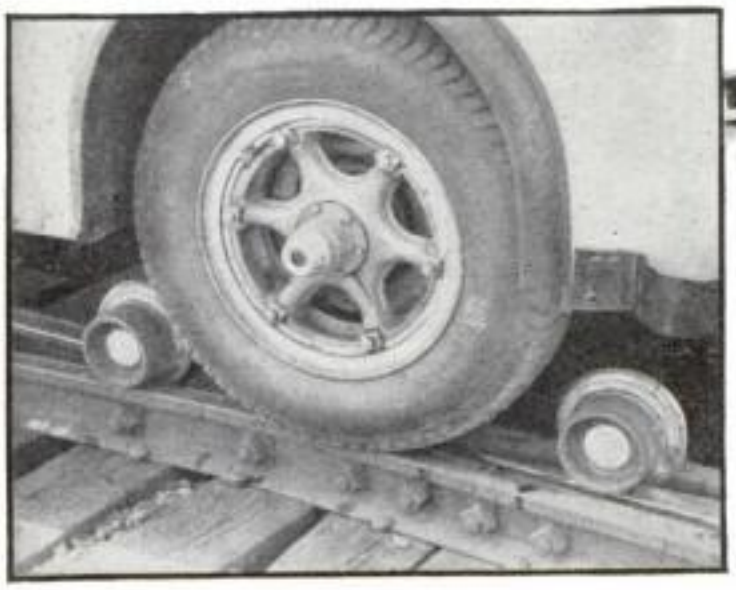
Above, using the new meter which gives right exposure time. At right, view showing windows for the photo cells

GUESSWORK is removed from picture-taking by a new meter that automatically reveals the correct exposure to use. A pair of photo-electric cells in this device measures the intensity of the light, which is indicated in units of light value by an electric needle on a dial. By referring to a table beside the dial, the proper exposure corresponding to the light value is found. Pressing a button on top of the instrument amplifies the swing of the needle exactly ten times for convenience in testing the comparatively weak strength of artificial light. While the new instrument is of more expensive design than other exposure meters of less precision, its first cost is its last, and it is built to last practically a lifetime, according to the maker who says its accuracy makes up for its cost.

Demonstrating the launching of a new lifeboat that has a connecting rod along the bottom by means of which both ends are freed at once

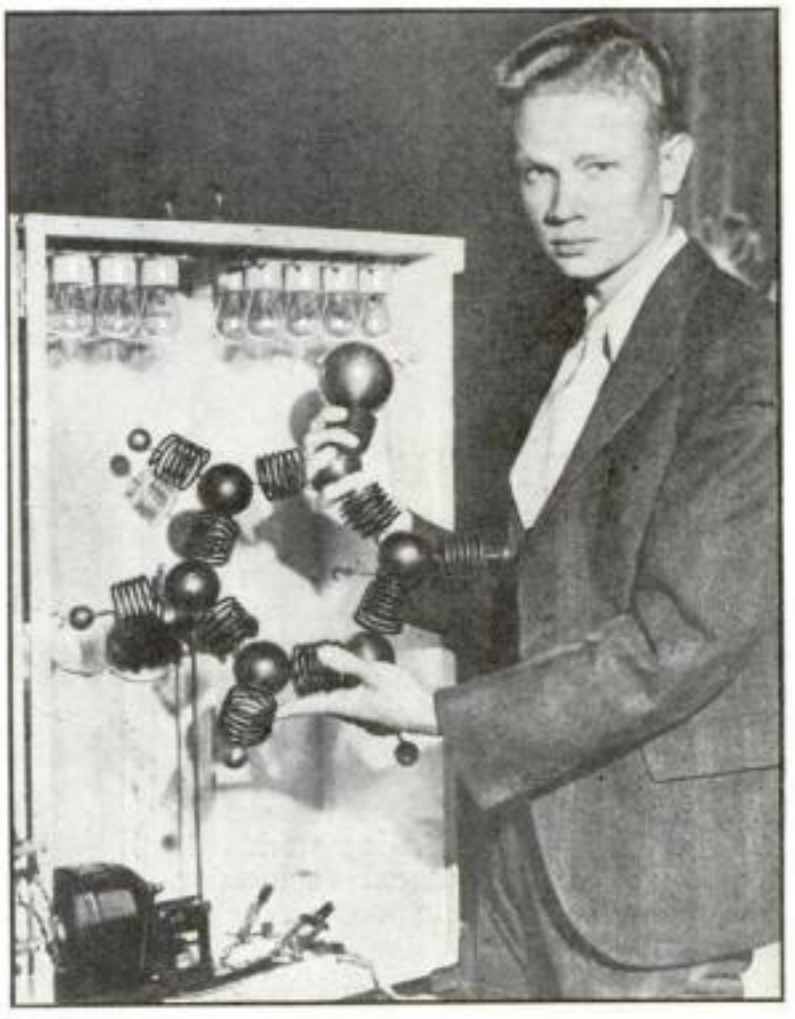
AMERICAN BUS CAN RIDE ON RAILROAD OR HIGHWAY

A MOTOR bus that rides on roads or rails with equal ease was demonstrated in Chicago the other day. Small flanged guide wheels, let down before and behind the main ones by a control beside the driver's seat, keep the odd vehicle on a railroad track as it rolls along on its rubber tires. While the first model was for passengers, others may carry freight. The road-or-rail coaches could be loaded at a factory, driven to a railroad, and formed in trains to be hauled to their destination, where they would leave the rails and proceed individually to consignees' doors. The buses would serve as passenger vehicles on branch roads. British lines have been trying out a somewhat similar vehicle for this purpose, known as the "ro-railer" (P.S.M., Apr., '31, p. 33).



This new bus, recently tried out in Chicago, is equally at home on steel rails or the paved thoroughfare

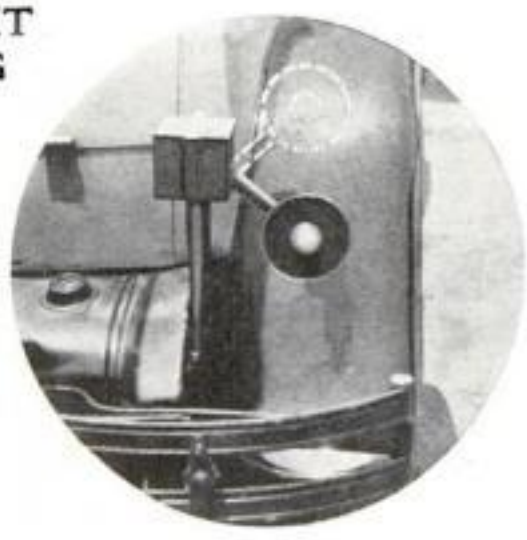
At left, view of the two flanged wheels that drop down to hold tire on railroad track and are raised when vehicle is on highway



Unusual model of chloro-benzine molecule. Balls are atoms

NEW AUTO STOP LIGHT WAVES ITS WARNING

A NEW rear stop light for automobiles attracts attention by swinging back and forth like the red warning signal at a railroad crossing. A small electric or vacuum windshield wiper motor operates the arm to which the light is attached. The switch or operating valve is connected to the foot brake so the light flashes on and begins swinging automatically when the brake pedal is pressed. The moving light, it is expected, will be more readily seen than the stationary kind.



Auto stop light swings its red warning

BOUNCING BALL TESTS POWER OF VOICE

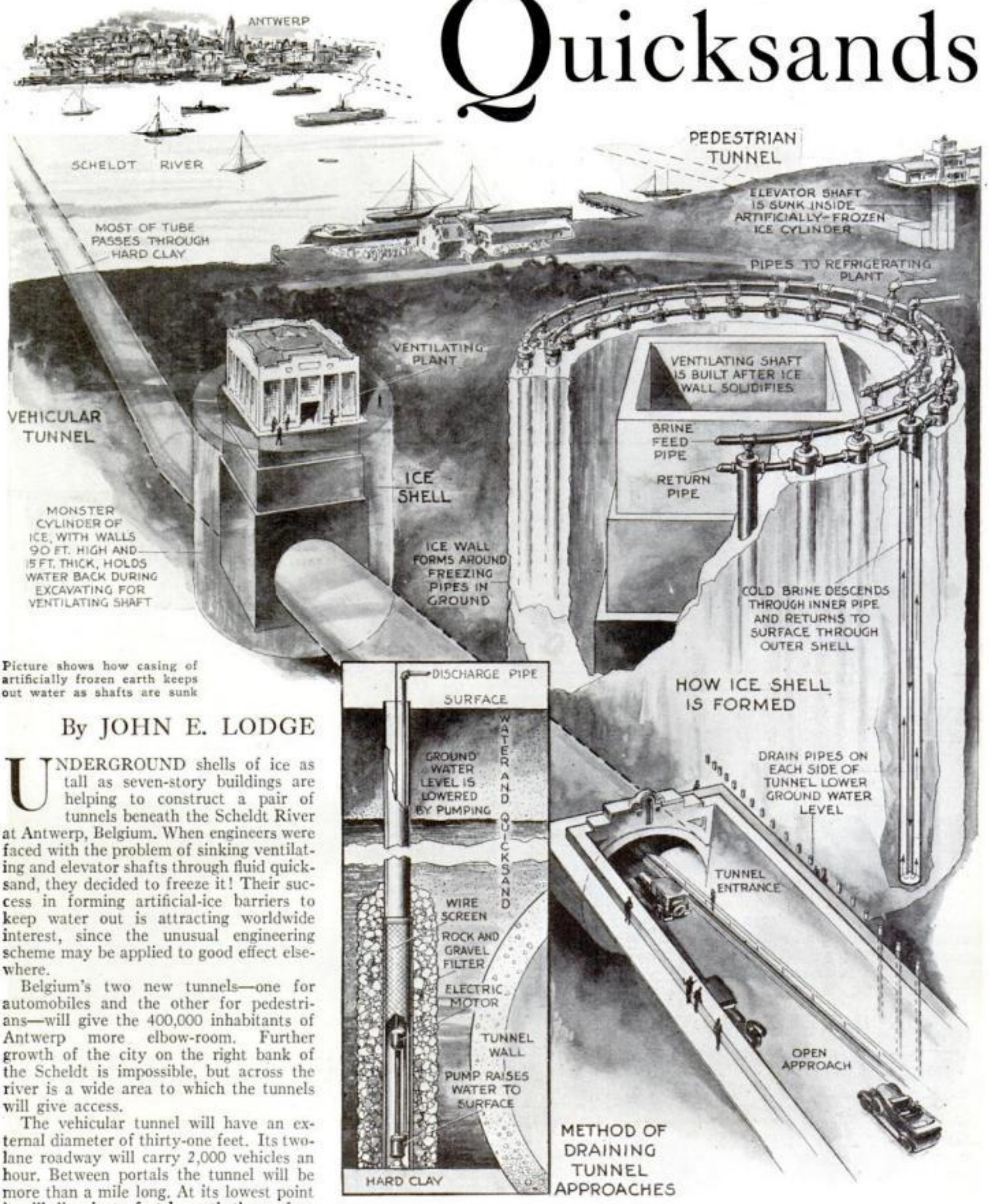
Power exerted by singer's voice is tested with this ball

A SINGER'S lungs need furnish only a trifling amount of air to fill a concert hall with sound, recent experiments indicate. To test the power behind the human voice, subjects at the phonetic laboratory of Hamburg University, in Germany, were asked to sing into a bouncing-ball device resembling a familiar child's toy. A typical singing voice proved capable of lifting the ball, which weighed half a gram (roughly, 1/50th of an ounce), to a height of seven centimeters (about 3 inches).

ATOMS IN MODEL OF MOLECULE BEHAVE LIKE REAL ONES

MODEL molecules behaved like real ones before a recent scientific meeting at Denver, Colo. They were built by Prof. Donald H. Andrews, of Johns Hopkins University, to test the theory that molecules are made of atoms leashed together by forces like springs. Engineers under his direction put metal balls and spiral springs together. Each ball represented an atom, and its size was in proportion to the atom's weight. When the models were shaken at different speeds by an electric motor they gave vivid proof, according to Dr. Andrews, of the accuracy with which science has pictured molecules. A model of a water molecule, for example, proved to have three vibration points. It was found that these corresponded almost exactly with three lines in the spectrum of water, believed to represent vibration points of the actual molecules.

Quicksands



Picture shows how casing of artificially frozen earth keeps out water as shafts are sunk

By JOHN E. LODGE

UNDERGROUND shells of ice as tall as seven-story buildings are helping to construct a pair of tunnels beneath the Scheldt River at Antwerp, Belgium. When engineers were faced with the problem of sinking ventilating and elevator shafts through fluid quicksand, they decided to freeze it! Their success in forming artificial-ice barriers to keep water out is attracting worldwide interest, since the unusual engineering scheme may be applied to good effect elsewhere.

Belgium's two new tunnels—one for automobiles and the other for pedestrians—will give the 400,000 inhabitants of Antwerp more elbow-room. Further growth of the city on the right bank of the Scheldt is impossible, but across the river is a wide area to which the tunnels will give access.

The vehicular tunnel will have an external diameter of thirty-one feet. Its two-lane roadway will carry 2,000 vehicles an hour. Between portals the tunnel will be more than a mile long. At its lowest point it will dip ninety feet beneath the surface of the Scheldt. The pedestrian tunnel is much shorter, measuring 1,750 feet from end to end. Elevators instead of long approaches with gradual grades will give access to this. Both tunnels traverse hard clay, offering no unusual construction difficulties for most of their length.

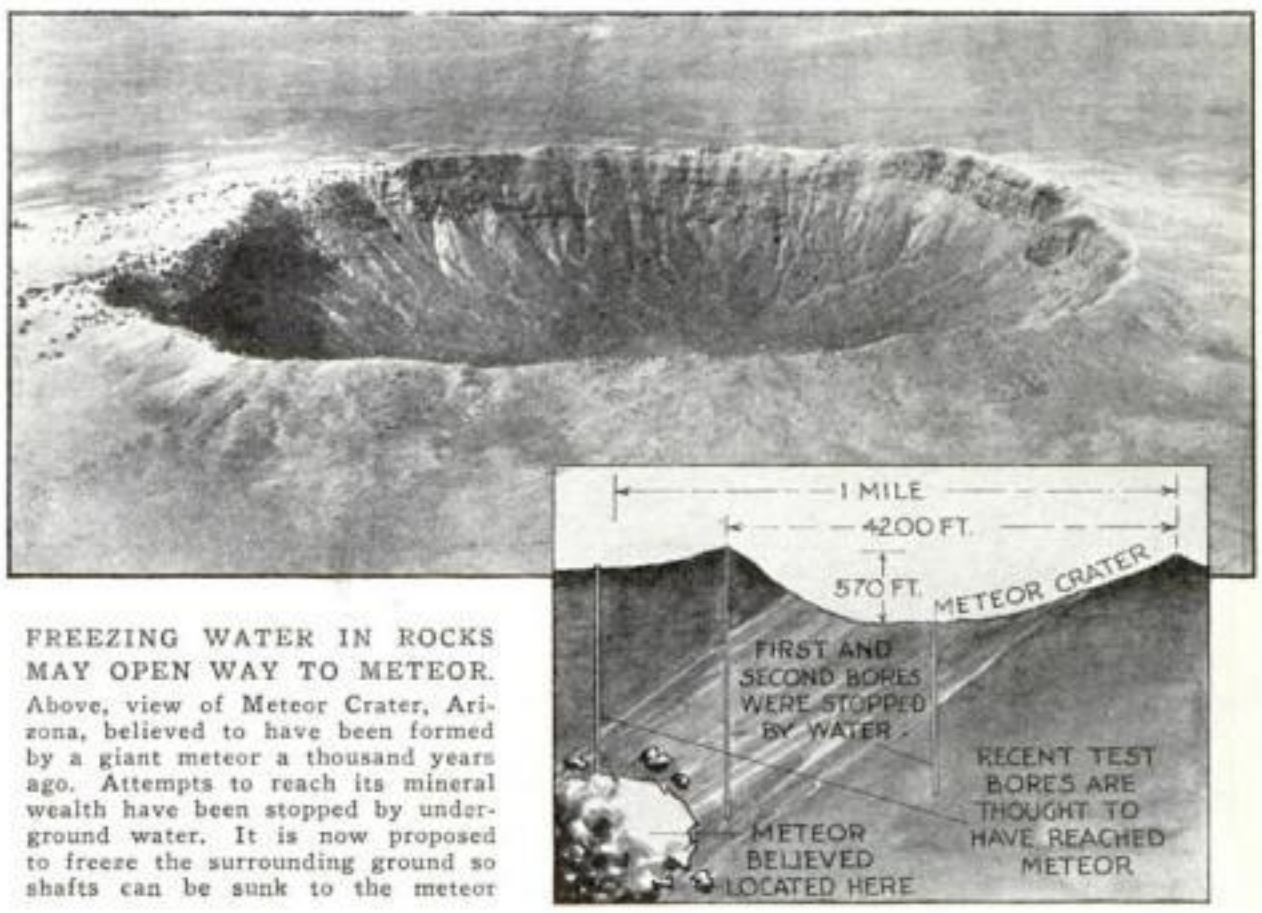
To reach this underlying clay, however, the tunnels must pass through a veritable quagmire on the left bank of the Scheldt. Here the low-lying land is composed of muddy flats and sandy stretches that rise only a few feet above the water at high tide. Accordingly, one has little more to do than scratch the ground to reach water.

At the open-cut approach of the vehicular tunnel, the engineers sank shafts along the sides. Electric pumps, placed in the holes, soon lowered the underground water level sufficiently to keep water out of the cuts while work was in progress.

This method, however, did not suffice to keep water from flooding the deep ventilator and elevator shafts that descend as far as ninety feet through quicksand to the tunnel bores. Americans would sink such shafts with caissons, under air pressure. The Belgian contractor chose a novel method that takes longer, but saves money and material in the end. He elected to

Frozen *to Dig Tunnels*

Engineers Startle World with Casings of Artificial Ice Around Ninety-Foot Shafts



FREEZING WATER IN ROCKS MAY OPEN WAY TO METEOR. Above, view of Meteor Crater, Arizona, believed to have been formed by a giant meteor a thousand years ago. Attempts to reach its mineral wealth have been stopped by underground water. It is now proposed to freeze the surrounding ground so shafts can be sunk to the meteor

freeze the ground, forming a rigid cylinder of frozen earth around the site of each of the deep shafts. Thus he demonstrated in practice the use of ice as a structural material, an idea already proposed and discussed by scientists (P. S. M., Sept., '32, p. 33).

Around the site of each shaft were first sunk about 120 holes in two concentric circles—the larger circle eighty-six feet in diameter, and the inner one, ten feet smaller. Into each hole was lowered a tube six inches in diameter and closed at the bottom. Then smaller pipes, with bottom ends open, were placed within the larger ones and the whole interconnected system shown in the diagram was filled with circulating brine from a refrigerating plant erected nearby.

Soon the fluid ground began to freeze around the pipes. Week after week the ice crystals spread until those from adjoining pipes met. Between three and four months from the time the brine was turned into the pipes, a single great cylinder of ice with walls fifteen feet thick surrounded the site of the shaft. So successfully has the man-made barrier kept out water that so far the digging has gone forward without difficulty. Since the frozen cylinder must be kept solid throughout the work, the circulation of brine goes on constantly, while tell-tale thermometers keep tabs on the temperature.

It is a long way from Antwerp to Meteor Crater, in the north-central section of Arizona, but it is suggested that the freezing method in use in the shafts at Antwerp may also be used in getting down through broken and water-bearing rock to a depth of 1,500 feet in quest of millions of dollars worth of nickel supposed to underlie that crater in the desert. Meteor Crater is 4,200 feet long and 4,000 feet across, and from rim to bottom of this vast bowl there is a drop of 570 feet. It is believed to have been formed a thousand or more years ago, when a meteor plunged earthward and struck the desert a blow so stupendous that it drove its way for more than 2,500 feet through solid rock and, in the course of a fraction of a second, excavated about 400,000,000 tons of rock!

Exploratory borings have brought up meteoric fragments rich in nickel; and the hidden mass has intrigued geologists, astronomers, and mining engineers.

Work to reach it was going forward confidently three years ago, and a test bore had been carried down about 660 feet when water unexpectedly and in large quantities entered the shaft. The pumps installed to handle seepage were unequal to the task, and the fine sand in the water soon incapacitated more powerful pumps.

Now an American expert, identified with the Antwerp tunnels, has said, that the freezing method used there probably can be applied successfully in getting through the troublesome ground at Meteor Crater.

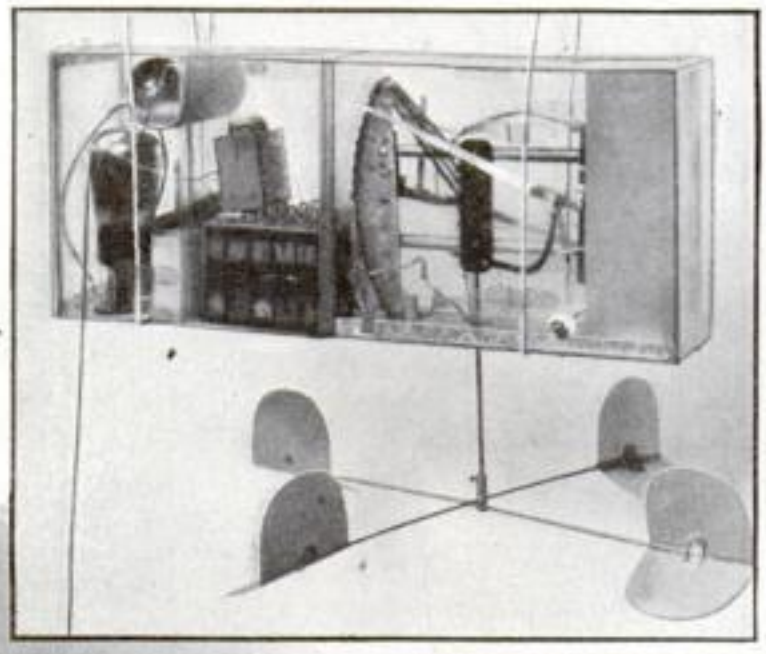
Talkie Gets Horseless Carriage

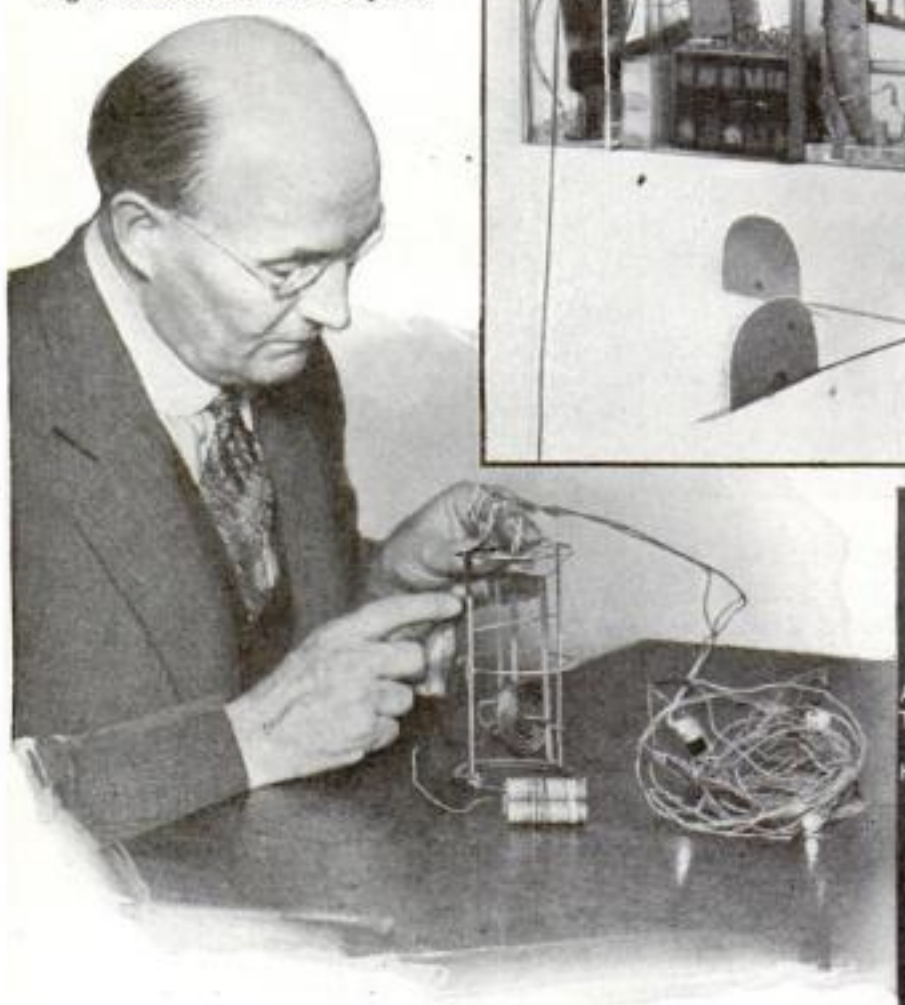
Below, drawing of steam-driven horseless carriage and, left, one resembling it made for talkie

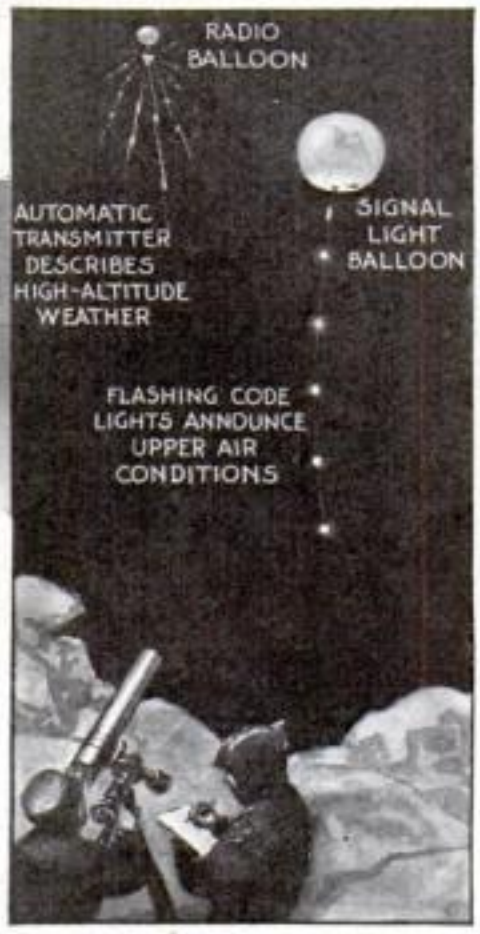
A HUNDRED-YEAR-OLD horseless carriage, driven by steam, has been constructed in Hollywood, Calif., for use in a talkie. The studio mechanics constructed the machine from old drawings of an English "boiler wagon" that is said to have puffed along a road near London long before the first gasoline engine made its appearance. With throttle wide open, the 1932 version attained a speed of nearly five miles an hour on its initial test. The driver of this ancestor of modern motor cars grasped a horizontal steering lever in his left hand and a clutch lever in his right. The wagon wheels on the car were shod with heavy iron tires to withstand the bumping over cobblestone roads. Behind the upright boiler, a fireman, standing on a small platform, kept up steam to drive the original horseless carriage as it rumbled over English roads.

Balloon Radio Seeks Polar Weather Secrets

Close-up, right, of radio sounder showing automatic mechanism for broadcasting data from balloon. Below, instrument with dangling electric light bulbs that flash reports







Drawing at right shows how new weather instruments will soar aloft in balloons and automatically report air conditions by radio and flashing code lights

Attached to balloon, this radio sounder houses a miniature radio set that will automatically broadcast data regarding temperature, humidity, and wind speed

TWINKLING lights and radio signals will bring automatic weather reports from the upper air when the "International Polar Year" expeditions penetrate the Arctic in 1933. Two balloon-carried instruments to aid in gathering data have just been perfected.

Red and white electric bulbs dangle on thirty yards of wire from one of these instruments, known as a "visual signal meteorograph," which measures temperature and air pressure. Automatic contacts will cause the lights to flash on and off in code signals, reporting the readings at different levels. Observers on the ground will watch the rising balloon through a telescope and interpret the signals. This device is the invention of a Canadian meteorologist. Another instrument will be an improved form of "radio sounder," devised by a Russian professor. It consists of a set of instruments and a miniature, automatic radio transmitting set that broadcasts the readings to observers.

COOKING KIT USES NEW FUEL

FUEL in paste form, made of solidified alcohol and packed in convenient tubes like shaving cream, operates a new miniature cooking kit. The oufit includes a folding stand to hold a pot and a small burner. Pressure on a spring lever opens the burner for filling the fuel reservoir. The burner top does not close air-tight, but allows air to enter around the lower edge for combustion.

ACCIDENT FINDS "LOST" PLANT

BY A lucky flick of his flashlight, Dr. Edward T. Wherry, of the University of Pennsylvania, recently re-discovered a plant that had been "lost" for 125 years. This rare variety of "alum root," a name that is applied to a number of species, was originally discovered by the German botanist Pursh in 1817. Believing that it could be found growing in America today, the University of Pennsylvania botanist led an expedition to White Sulphur Springs, Va., in search of it. The hunt was fruitless until Dr. Wherry accidentally struck his flashlight button as he plodded through the darkness. Beneath the lamp's beam was the lost plant.

To keep government crop reports secret, this locking bar, seen at left, was invented to hold shuttered windows tightly closed. Below, armed guard standing in front of room in which the reports are compiled

Guns and Bars Guard U. S. Crop Reports

GUNS and barred windows will henceforth guard the U. S. Department of Agriculture's seasonal crop reports from prying eyes, until they are ready for the public. The extraordinary precautions follow disclosures calling to mind war-time activities.

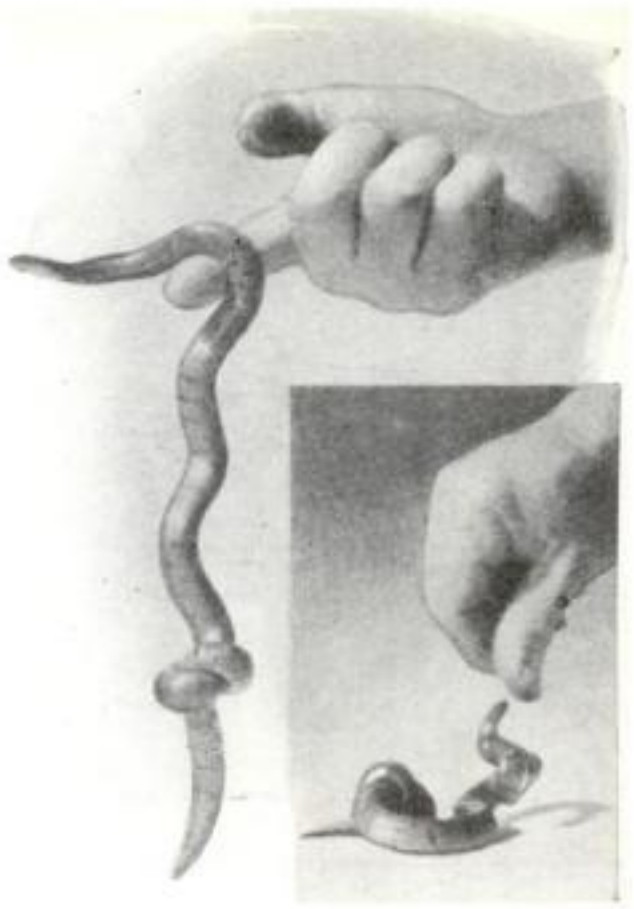
Some time ago a sensational "leak" of advance information on the cotton crop dismayed Department officials and precipitated an investigation. Corrupt employes of the crop reporting board, according to the testimony, used window shades of the board room to signal observers across the street. If a certain curtain went up, the crop was better than expected. If it went down, the crop had failed. Unscrupulous speculators were alleged to have made fortunes in this way.

To prevent such leaks, the following procedure has been adopted:

Reports from individual states, on which the Department of Agriculture report is based, are sent under seal to the Secretary of Agriculture at Washington, D. C. He puts them in a strong box that requires two keys to open. The Secretary keeps one key; the other is held by the chairman of the crop reporting board.

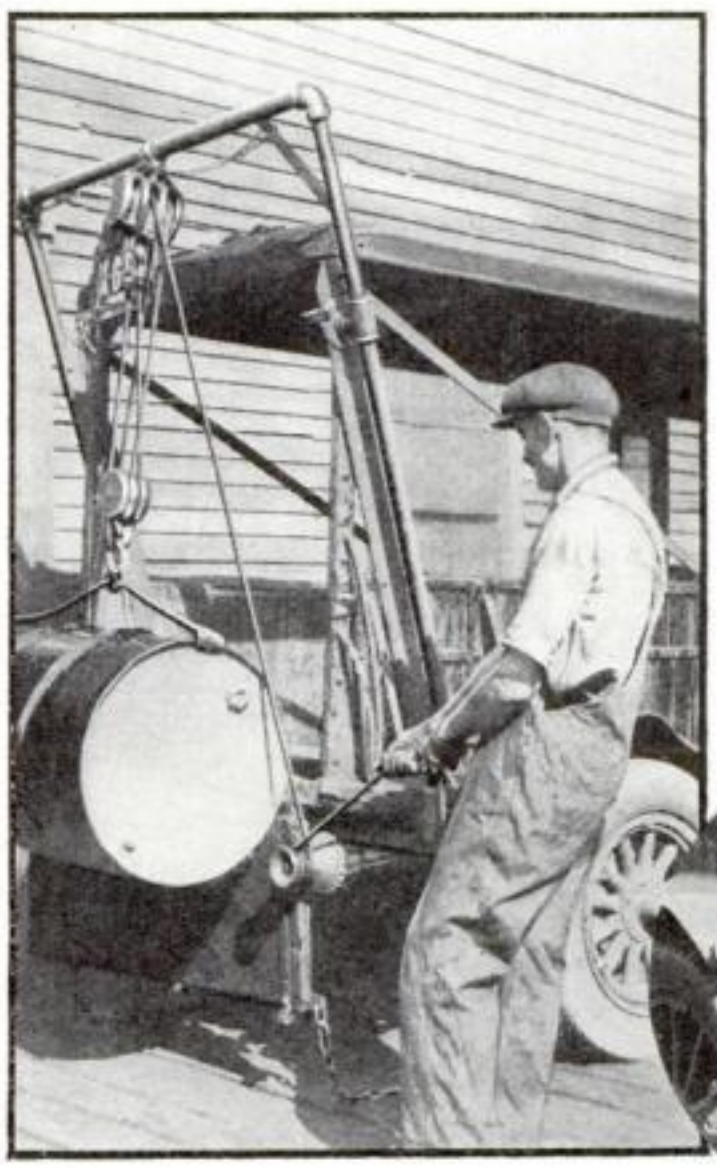
When the day chosen for the national report arrives, the chairman goes with an armed guard to the Secretary and obtains the state reports. He brings them back to the board room, where members of the board and their statisticians are already assembled. While the national report is being prepared, occupants of the room are completely cut off from the outside world. Shutters on the windows are closed, and are kept inviolate by a new device worked out by the Department's mechanics. This consists of a wooden bar holding the shutters flat, secured at one end in a metal slot and at the other with a hook and a wire that cannot be removed without destroying a seal. Policemen stand on guard at the door with revolvers.

Then newspaper reporters are ushered into a room equipped with a battery of telephone and telegraph instruments. At a given signal, they pounce upon copies of the report. A second later, its contents are being flashed to every part of the country.



SNAKE TIES ITSELF IN KNOT TO CURE INJURY

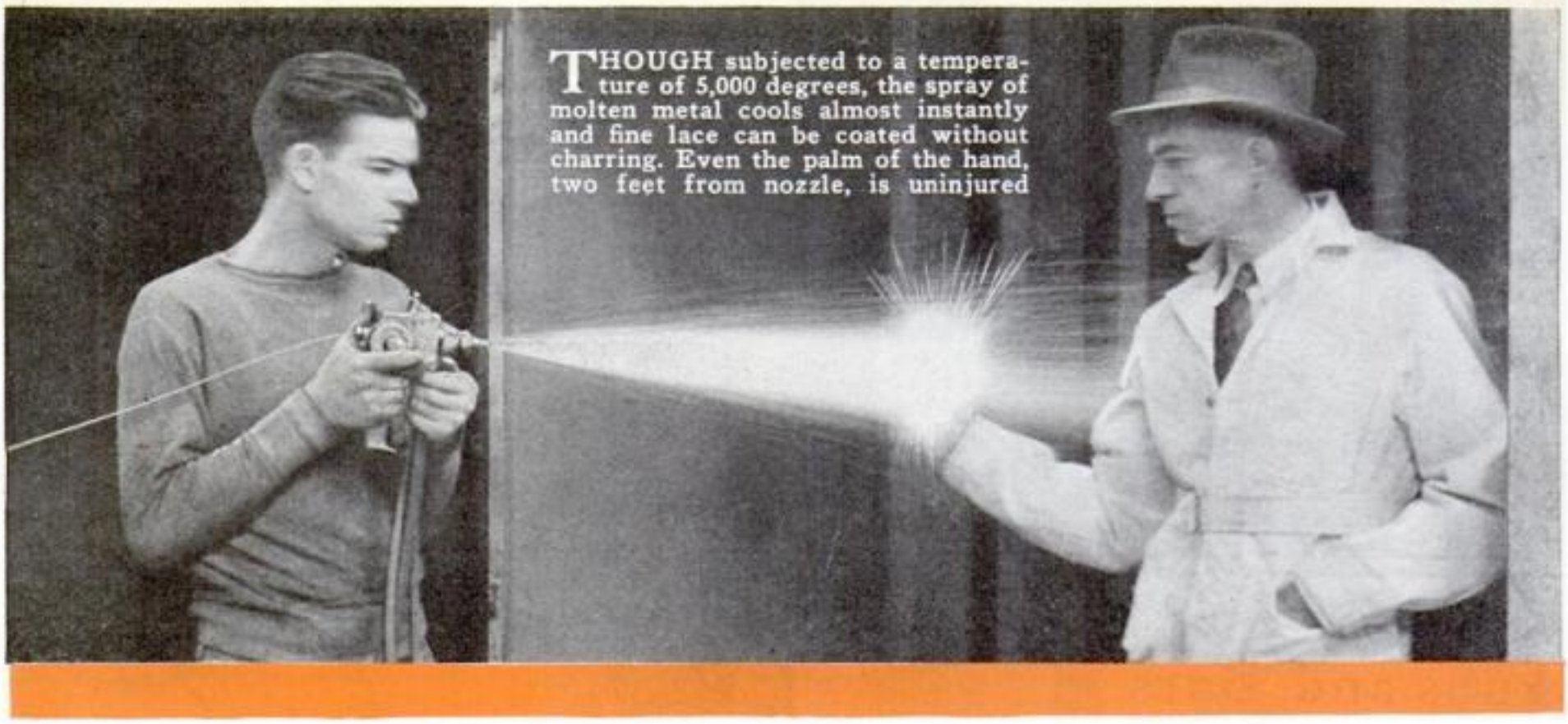
A SNAKE became its own surgeon in a remarkable feat observed not long ago by R. S. Walker, Chattanooga, Tenn., naturalist. When this snake was captured its back was found to have been broken. The body drooped limp below the injury. The snake was placed in a hibernating box and left for several days. When it was withdrawn, the snake was found to have tied a knot in its body at the point of the injury. The knot held the fracture until it healed.



Five hundred pound barrels are loaded onto this truck with a hoist operated by power from the car's motor

USES TRUCK ENGINE TO LOAD BARRELS

A HOMEMADE hoist, operated from the motor of his truck, helps Frank McDonald, of Portland, Me., to load 500-pound barrels of cod liver oil aboard. The barrels are left for him on the wharves by fishing vessels. To ease the task of loading them, McDonald mounted a special fitting at the front of the car, taking power from the motor's crankshaft at the point where the crank handle is usually inserted. By means of gears and a winch, he transferred the power to a hoisting rope at the rear of the truck. A switch permits the operator to stop the motor.



THOUGH subjected to a temperature of 5,000 degrees, the spray of molten metal cools almost instantly and fine lace can be coated without charring. Even the palm of the hand, two feet from nozzle, is uninjured

NEW TOOL, *like Paint Gun*, Sprays Mist of Molten Metal

HISSING determinedly and spurting a tiny flame, a tool, looking not unlike a paint sprayer, moved slowly back and forth over openings in stencils fastened to long panels of silvery metal. Not paint, however, was being applied to decorate these sections of aluminum doors and door frames that soon would be part of an ultra-modern New York skyscraper. The fine spray, leaving a glittering trail as it passed, consisted of atomized particles of molten bronze forced out by air pressure.

A thousandth of an inch thicker at each pass, the strange tool was building up an inlaid design of genuine bronze, joined as permanently to the aluminum base as if it were welded there.

One more had been added to the scores of recent applications of sprayed molten metal—an almost miraculous process that has long been making revolutionary advances in industry, and more recently in pottery and sculpture.

From bolts to bridges, from small refrigerator coils to huge storage tanks and steamships, sprayed metal coatings now protect iron and steel equipment from destruction by corrosion. Aluminum coatings, by no other means commercially applicable, are being given wholesale to furnace grate bars, locomotive and steamship boiler tubes, ovens, electric heater resistances, pistons and explosion chambers of internal combustion engines, glass-making tools, and varnish kettles. Tin is being applied by this method on great cooking vats. Copper and lead coatings are being sprayed by this new process on glass and other di-electrics to form the plates of electric condensers.

Unable with existing equipment to manufacture cable wires as long as were needed for the great span of the George Washington bridge, over the Hudson River, the builders were confronted with the problem of producing a joining device that would not reduce the strength of the wires and that would be permanently secure from corrosion. The ends of the galvanized strands were finally threaded and screwed into high-carbon steel ferrules. Permanently to exclude the effects of moisture, each of the several hundred thousand threaded ends and ferrules was sprayed with molten zinc—securing a better protection at the joints than that provided by the galvanizing on the regular stretches of the gigantic wire cables.

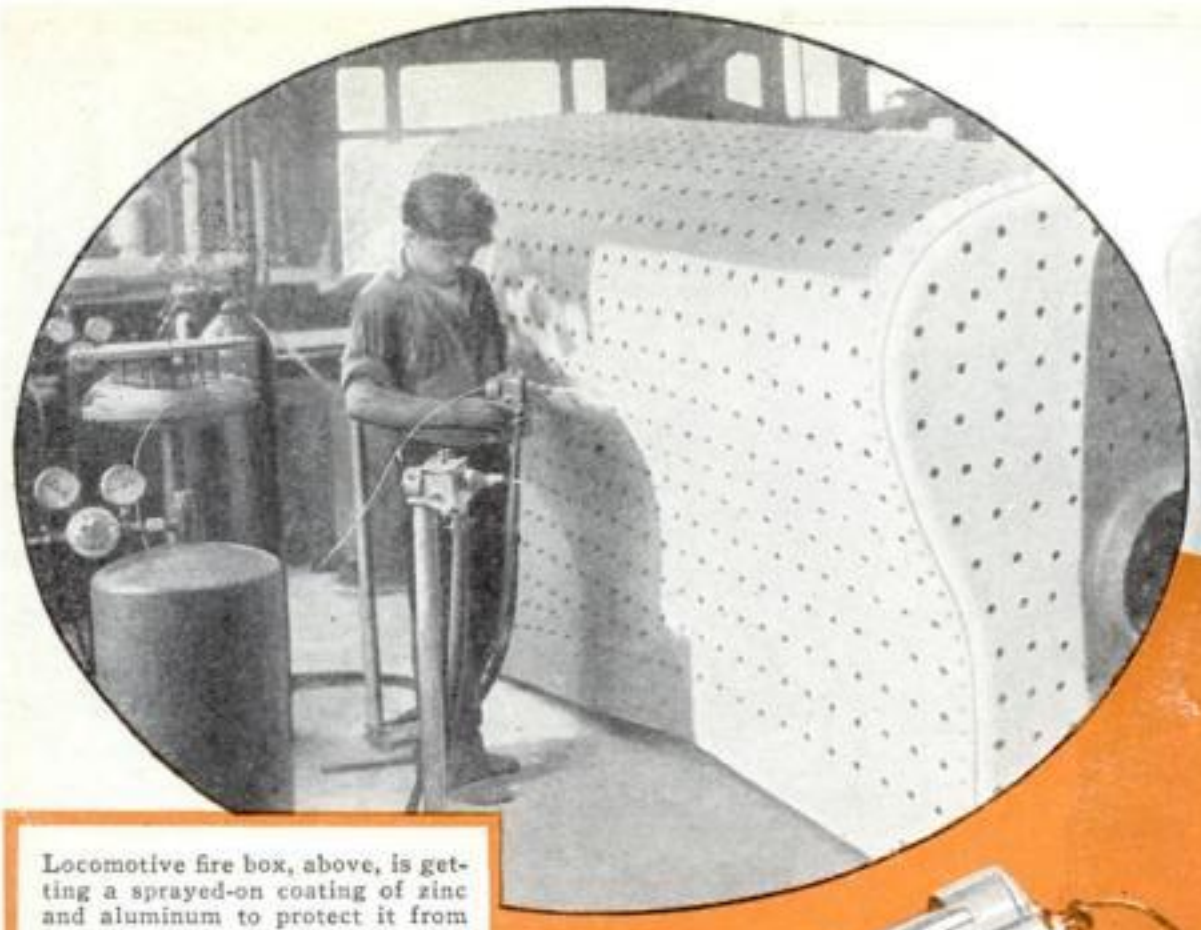
Not only zinc, aluminum, lead, and copper, but gold, silver, nickel, bronze, brass, iron, cadmium, German silver, stainless steel, and practically any other commercial metal may be easily applied by spraying.

In the field of ceramics, sculpture, and architecture, the use of sprayed metal opens wide new possibilities. Articles of pottery, coated with dull or shining metal instead of the usual glazes, are already attracting attention on the market. Decorative architectural pieces, cut in stone

OBJECTS OF ART AND INDUSTRY

By the new process, a coating of metal can be sprayed on lace, pottery, sculpture, or even the inside of pipes

By Kenneth M. Swezey



Locomotive fire box, above, is getting a sprayed-on coating of zinc and aluminum to protect it from the effects of heat. At right, the molten metal machine in use. Note wire that supplies the metal

Remarkable Process Gives Metal Coating to Any Material from Steel and Sculpture to Fine Lace and Paper

or molded in one of the baser metals, have been coated with metals such as bronze or aluminum. Plaster casts of statues may be so coated and finished that only with difficulty can they be distinguished from solid metal.

An amazing thing about the metal-spraying process is that the resultant coating is hard and cold almost instantly. Thin paper and delicate lace may be sprayed without the slightest charring.

The basic principal of this modern and far-reaching technical achievement, was worked out in Europe, but it was developed to its present state of perfection by American engineers who quickly sensed its possibilities.

The inventor of the process discovered that coatings of many common metals such as lead, zinc, and aluminum could be applied permanently to properly prepared surfaces by spraying them with atomized particles of molten metal hurled forth by compressed air. In practice, a wire of the desired metal was fed into a spraying tool, melted immediately in front of the nozzle by an oxy-acetylene flame, and atomized and blown out by a powerful stream of air.

Containing in principle the basis of a revolutionary invention, this early apparatus was found lacking in the essential commercial requirements of uniform operation and control.

Engineers here recognized both the potentialities and defects of this European equipment. For years, they experimented with the apparatus to the end of discovering the exact requirements for the perfect operation of a metal sprayer under all working conditions.

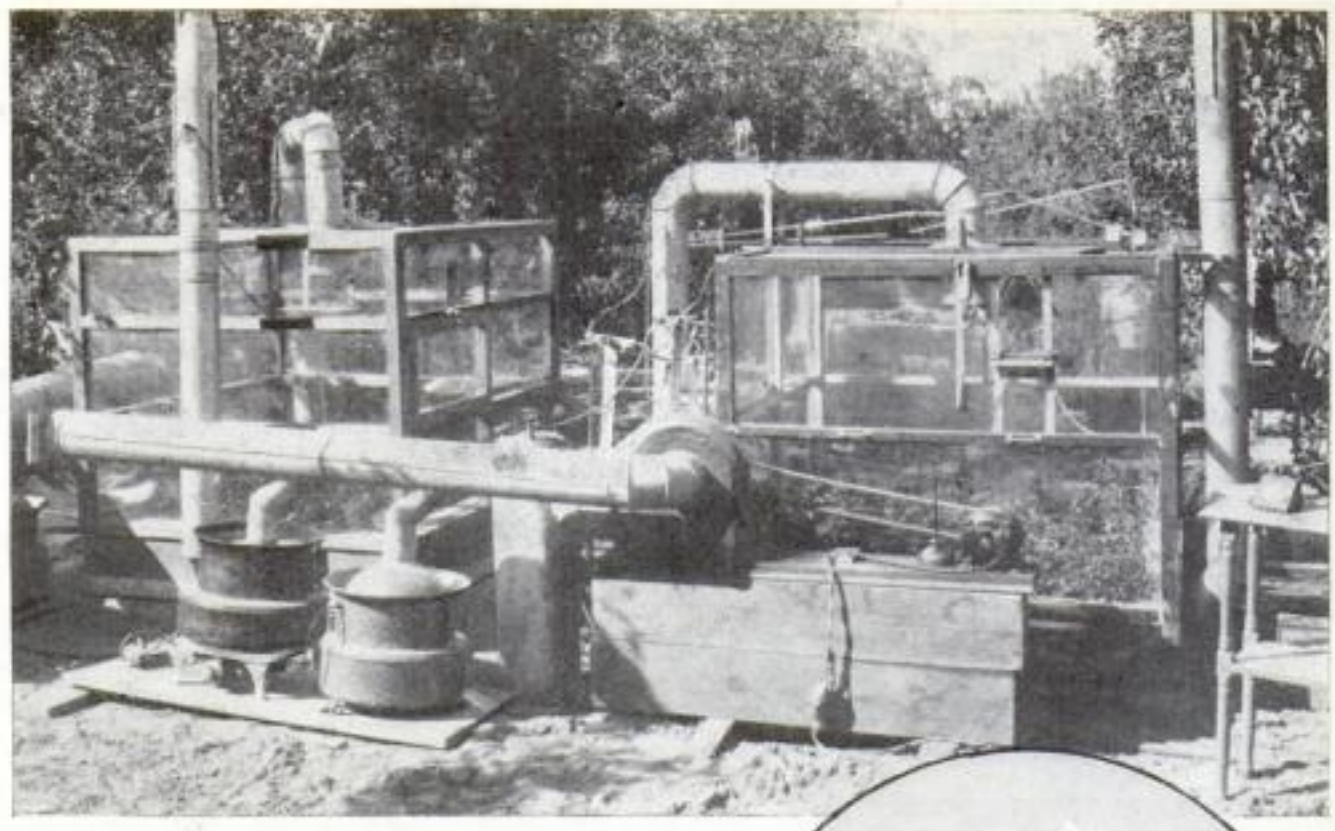
The resultant apparatus, based on their findings, was essentially the metal-spraying apparatus of today. Weighing only three and a half pounds, and capable of being precisely regulated to compensate for the differences in the melting points and thicknesses of wires of the various metals used, the new spraying gun is as easy to manipulate as a welding torch or a paint sprayer.

In the latest type of spraying gun, metal in the form of standard gage wire is automatically pulled from a reel by a compressed air turbine and passed uniformly, at a rate of twelve to twenty-four feet a minute, into an oxy-acetylene reducing flame. Immediately and continuously the tip of the wire is melted, atomized, and blown in a fine spray, by air at a pressure of fifty pounds per square inch, onto the surface to be coated. The tool may be so adjusted that the wire is passed into the flame at a rate exactly sufficient to absorb the heat units therein. A miniature cupola furnace, in other words, the melt and pour of which may be adjusted with watch-mechanism precision!

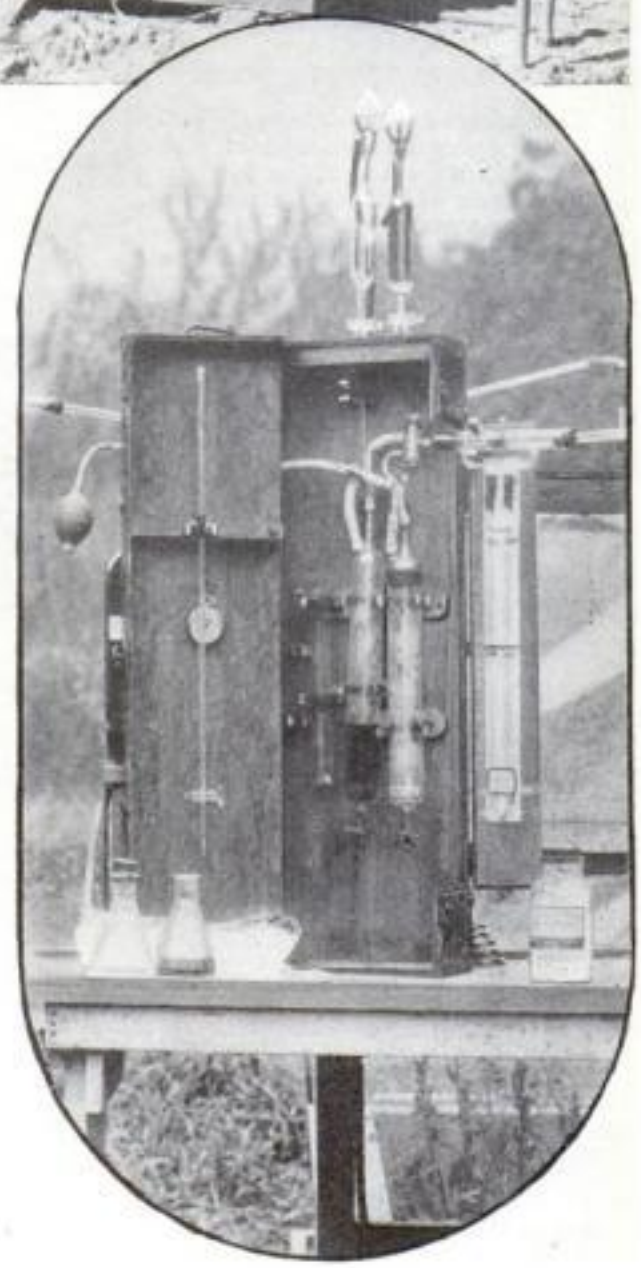
In use, the sprayer is passed across the surface to be coated at a uniform distance of about four inches. At that distance the spray covers an area slightly less than two inches in diameter, and a single pass deposits a coating about one-thousandths of an inch thick. The operator's vision easily guides him in distinguishing between the coated and uncoated portions and between the first and succeeding coats. By repeating the passes, coatings may be built up to any reasonable thickness—even heavy bars of solid metal may be produced.

On a properly prepared surface, generally roughened by sandblasting in the case of wood or metal, the coating becomes practically integral, has all the characteristics of metal cast by more ordinary means, and may be hammered, filed, polished, or otherwise finished, without loosening. Thousands of shells have been coated with zinc, copper, and lead, to correct imperfections *(Continued on page 109)*

Department of Agriculture experts are using the apparatus, right, to test the effect of small amounts of sulphur dioxide gas upon field plants, small trees, and weeds in a closed chamber. The amount of gas used is about the same as comes from the big factory smokestacks



The coal held in the chemist's hand contains enough sulphur to tip the heads of six packages of matches. Burning the coal releases sulphur dioxide gas



Sulphur dioxide detector, right, that can be carried from place to place to test air for poison gas. It is so sensitive it can detect one part of the gas in 50,000,000 parts of air. It will be used to warn of air pollution that might prove fatal both to plants and persons

New Ways to Fight POISON FOG

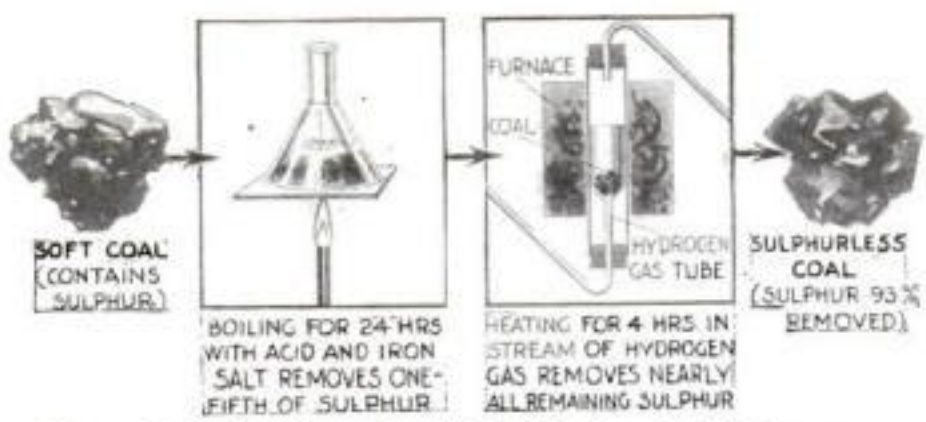
POISON fog claimed the lives of sixty Belgians, two years ago. Now it may be banished forever, by two outstanding inventions reported to the American Chemical Society. One is a super-sensitive detector that warns when sulphur dioxide gas—the deadly element in poison fog—reaches a dangerous concentration in the air. The other, a process for making "sulphurless coal," would remove the source of the menace if applied commercially. It is the sulphur, found as an impurity in all kinds of coal, that produces sulphur dioxide gas when the coal is used as fuel in factories.

When a malignant vapor hung day after day over the Meuse Valley of Belgium and felled scores of men and hundreds of cattle, chemists rushed to the scene. They identified the phantom destroyer as sulphur dioxide gas belched from factory chimneys. The acid-forming gas, collecting on fog particles floating in the air, seared the lungs of those who breathed it.

Extraordinary weather conditions abetted the Belgian fog—cold lower air and continued absence of wind. Such a combination might recur only once in many years. Even in lower concentrations, however, sulphur dioxide gas from factory smokestacks constantly imperils the health of city dwellers, attacks steel and masonry structures, and reduces the yield of crop plants.

Hence two U. S. Department of Agriculture chemists, S. W. Griffin and W. W. Skinner, have just perfected a portable detector that may be set up anywhere to measure traces of sulphur dioxide in the atmosphere. It can detect one part in fifty million parts of air, using a chemical reaction in which a solution of common iodine is the reagent. If much gas is found inhabitants may be warned.

Meanwhile Dr. Robert D. Snow, of the University of Illinois, announces a method to rid coal of sulphur. On a laboratory scale, he has succeeded in eliminating as much as ninety-three percent of the sulphur. The coal is ground to powder, boiled twenty-four hours in acidified ferric sulphate solution (a salt of iron), then kept at a high temperature for four hours while a stream of hydrogen gas passes over it.

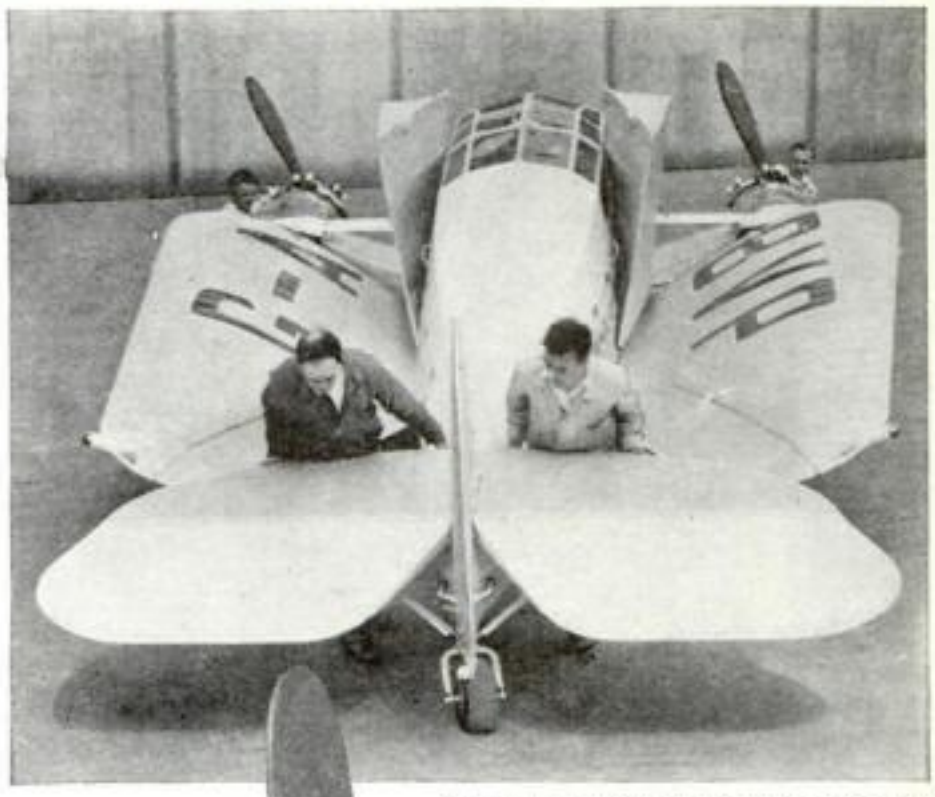


How Sulphurless Coal Is Made in Laboratory

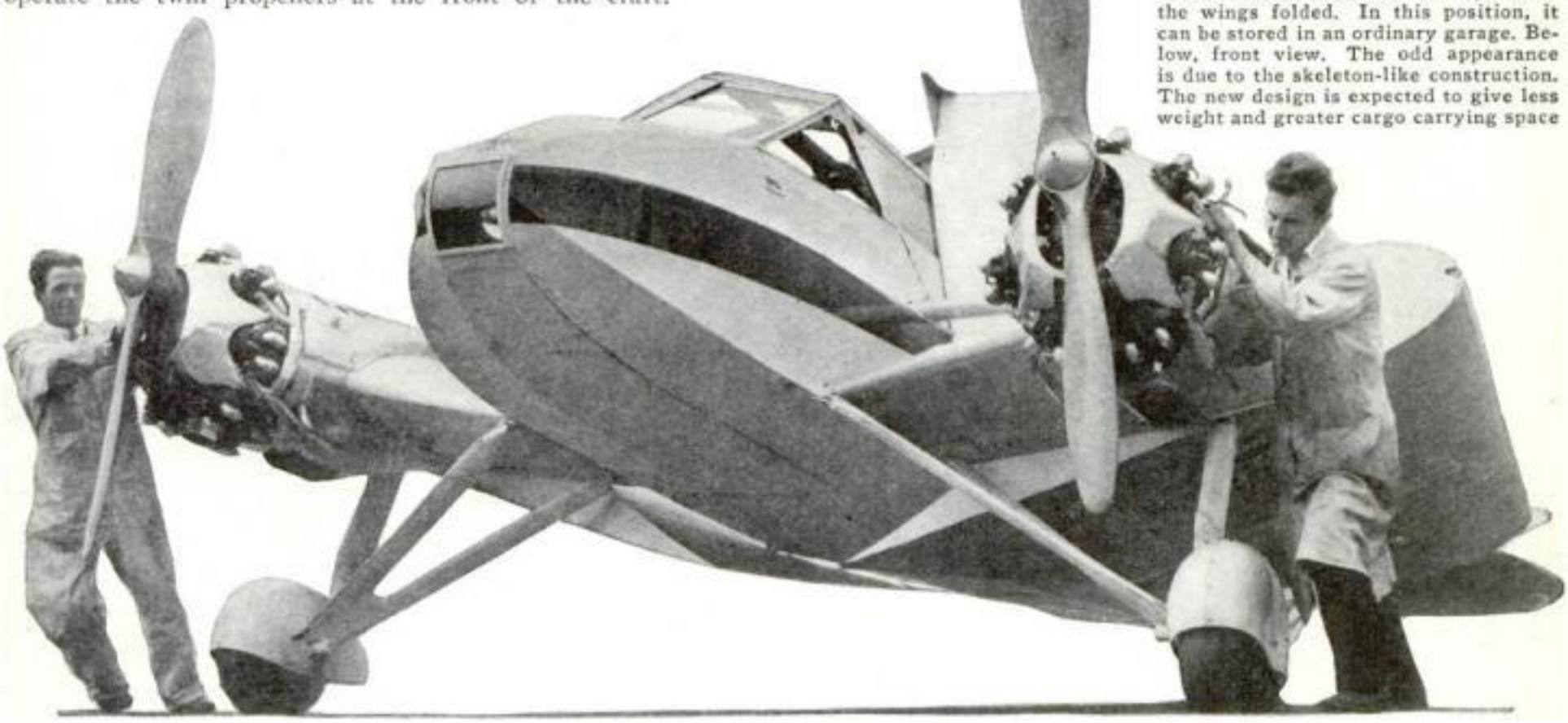
New British Plane Has Hinged Wings

New mono spar plane in flight with the hinged wings extended and locked in place. Auxiliary sections swing down from fuselage to complete the wing line

AIRPLANES with folding wings have been built for years, but a radically new style of folding craft recently made its appearance at the Croyden airdrome near London, England. Known as the "mono spar plane," it is expected to solve the problem of reducing weight, and increasing cargo and passenger capacity. The wings swing into flying position upon hinges at the leading edge, while auxiliary sections swing downward from the fuselage to complete the unbroken wing line. Two motors operate the twin propellers at the front of the craft.

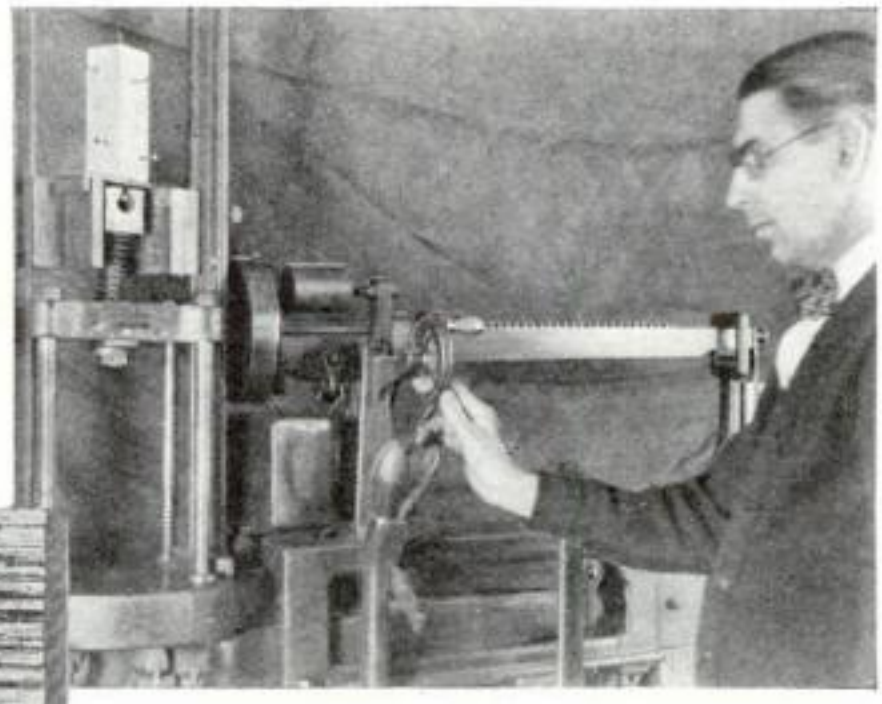


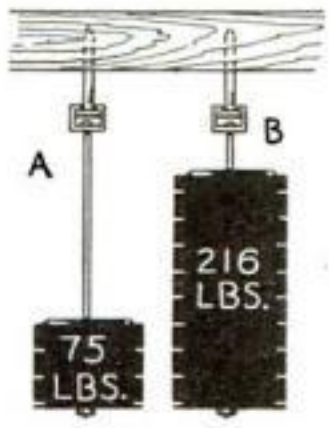
Above, rear view of the mono spar with the wings folded. In this position, it can be stored in an ordinary garage. Below, front view. The odd appearance is due to the skeleton-like construction. The new design is expected to give less weight and greater cargo carrying space



NAILS, WITH ROUGH SURFACE, HAVE GREAT HOLDING POWER

Below, a cut-away piece of wood to show how new nail pushes wood fibers apart as it enters block. These fibers cling to nail's rough surface





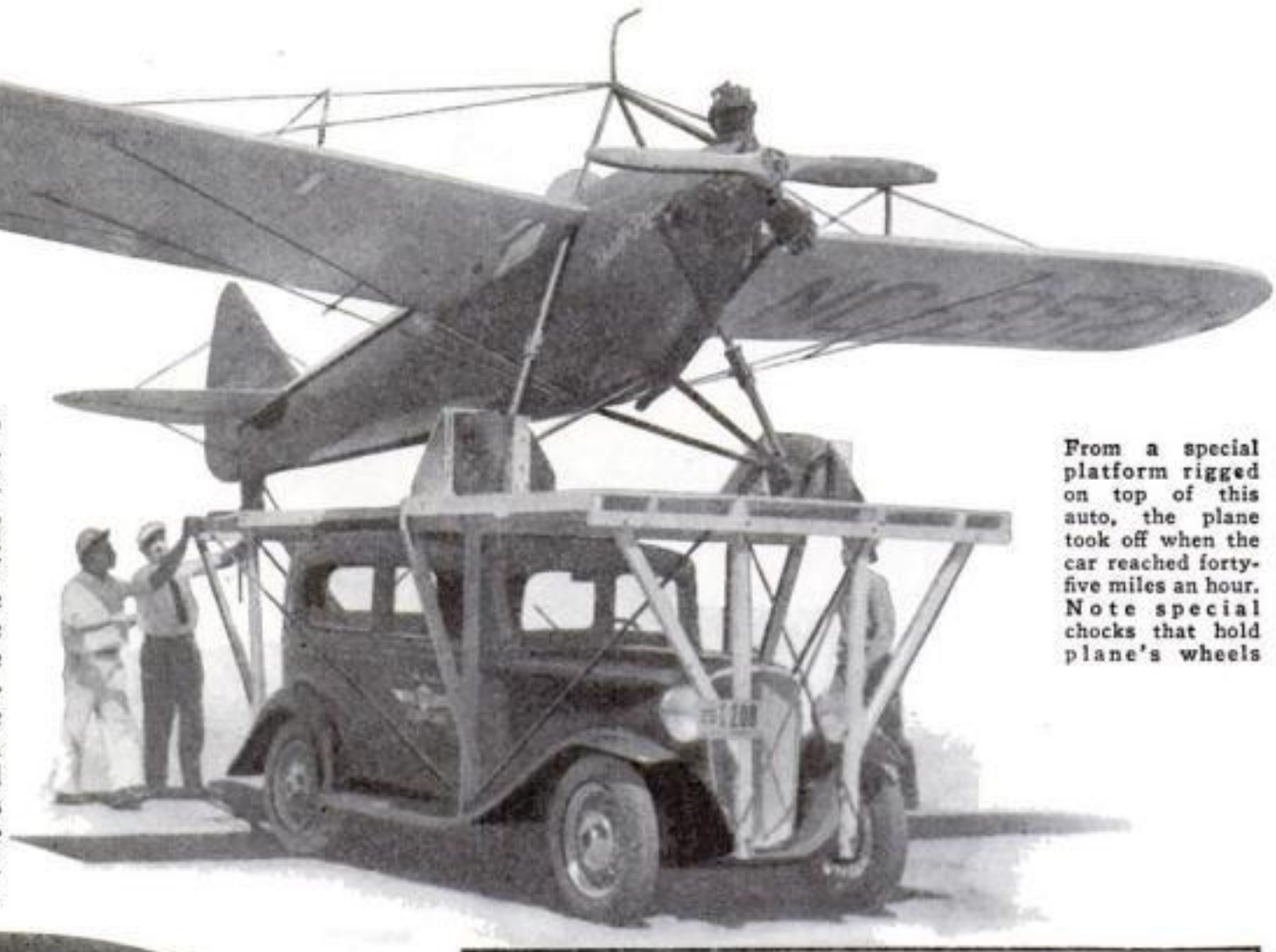
With the apparatus shown above, the holding power of the new nail was tested and, as drawing at right shows, nearly three times as much force, at B, was required to pull new nail B as old, at A. Etched surface accounts for this difference

A NEW nail with nearly three times the holding power of an ordinary one has been developed at the U. S. Forest Products Laboratory, Madison, Wisc. The secret of its increased efficiency is a roughened surface, barely noticeable to the eye, which enables wood fibers, into which it is driven, to cling to it more tenaciously. This surface is produced by etching the nails in an acidified solution of ferric and mercuric chlorides. When tested at the Wisconsin laboratory with a special nail-pulling apparatus that records, to the minute fraction of a pound, the force exerted, the new nails required a pull of 216 pounds to extract them. Common nails of the same size, driven into the same piece of wood, pulled out at seventy-five pounds.

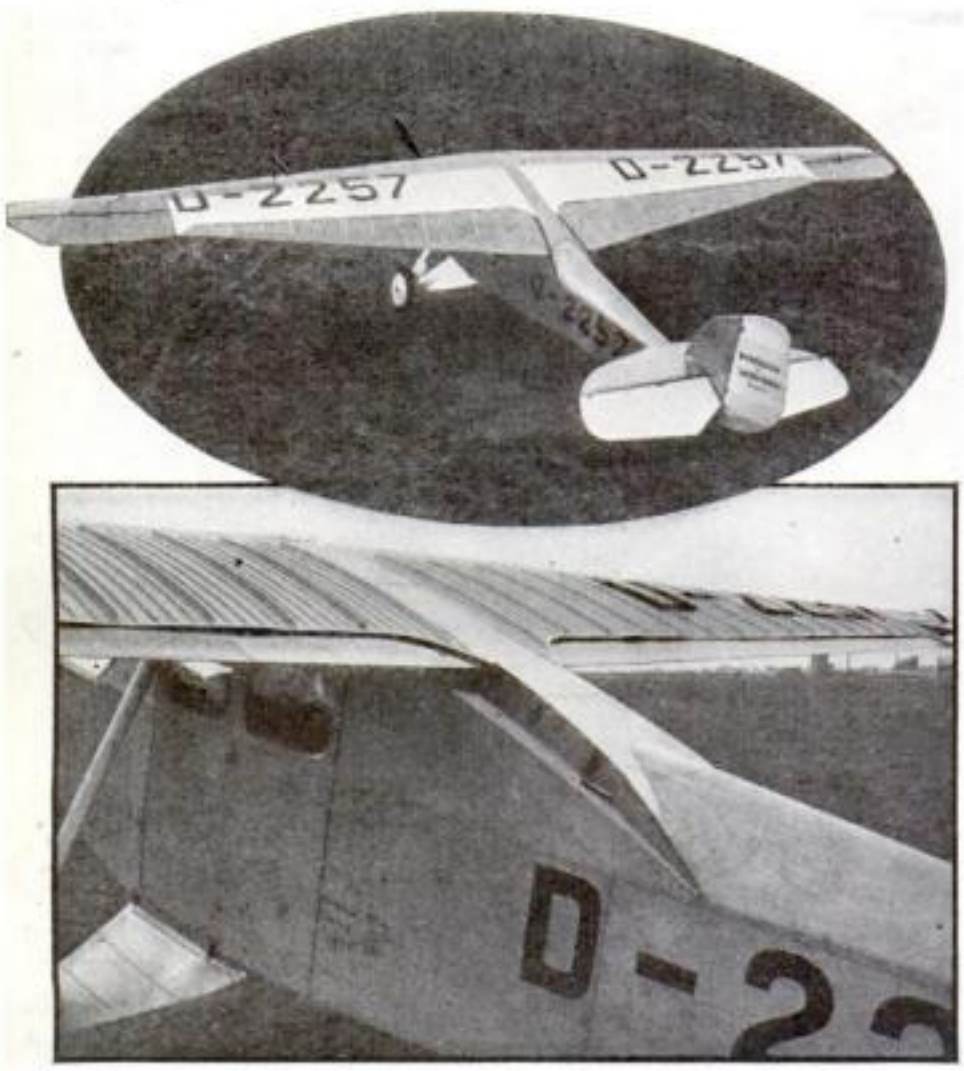
Since the fibers cling tightly to the new nails, the decay of the wood around them is expected to be unusually slow.

PLANE TAKES OFF FROM CAR'S ROOF

CATAPULTING an airplane into the air from the top of a speeding automobile was a feat carried out successfully, the other day, at Los Angeles, Calif. A special platform was built on the roof of a standard sedan. When the airplane was in place and the pilot ready at the controls, the car started down the Metropolitan Airport field at forty-five miles an hour. The pilot, O. C. La Boutillier, found that he could launch his machine from this novel catapult 300 feet from the start. This method may be used to launch planes in small space.



From a special platform rigged on top of this auto, the plane took off when the car reached forty-five miles an hour. Note special chocks that hold plane's wheels



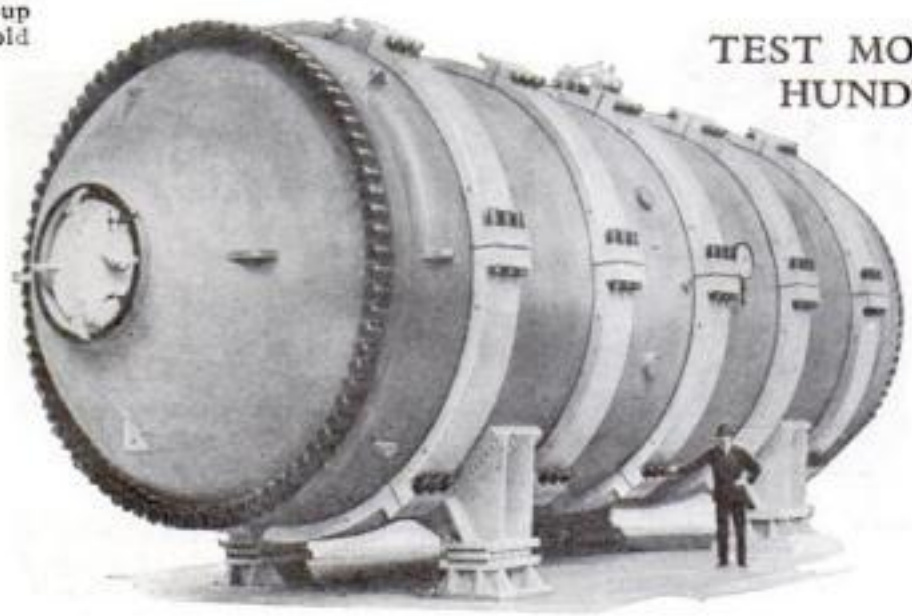
In oval, expanding wing plane with fins extended to give increased wing surface. Above, close-up of plane showing slots into which the fins fold

PLANE, WITH EXPANDING WINGS, FLIES IN TEST

A NEW type of airplane with expanding wings was recently flown in Germany. Supplementary wing surfaces or fins, one on each side of the fuselage, fold into slots in the main wing or slide outward between guiding rollers to increase the area of wing surface. The pilot may alter the size of the wings while in flight in accordance with his altitude and speed to secure the maximum lifting efficiency. Controls for this purpose are mounted within his cockpit.

FLYER MISSES TRUCK BY INCHES

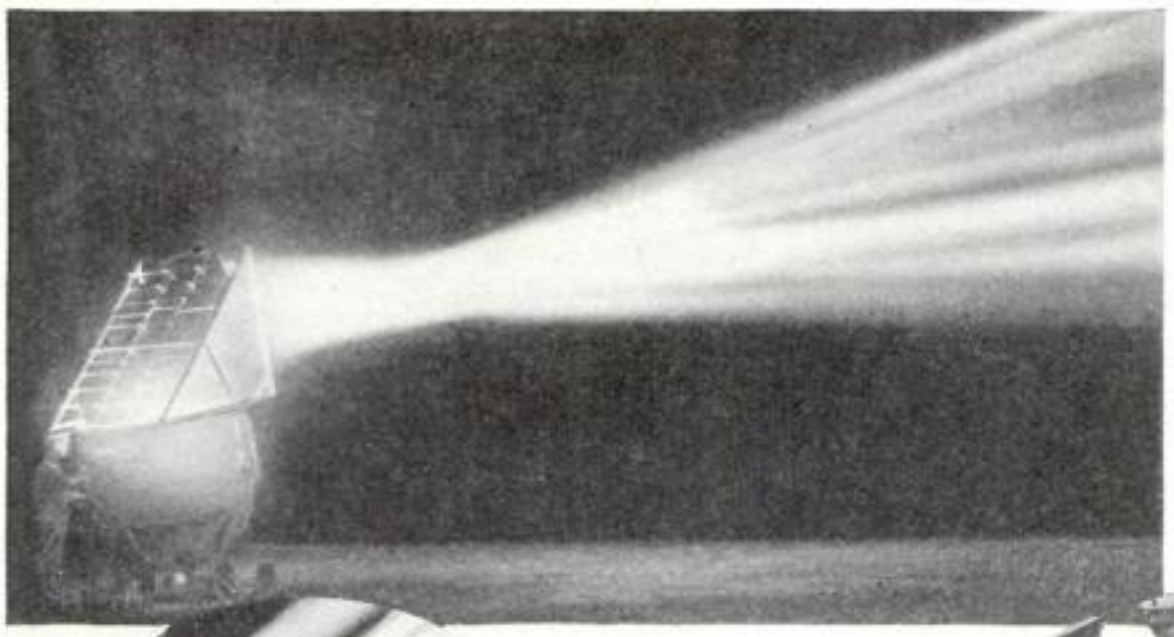
NO WONDER the driver of the truck, in the picture above, put out his hand and slammed on the brakes. A fast plane roared down out of the sky and missed him by inches. The close shave occurred near a Washington airport when a contestant in a transcontinental race was practicing landings. Bystanders tried to stop the truck driver, but he missed seeing their signal. A cameraman was successful in recording this strange traffic hazard.

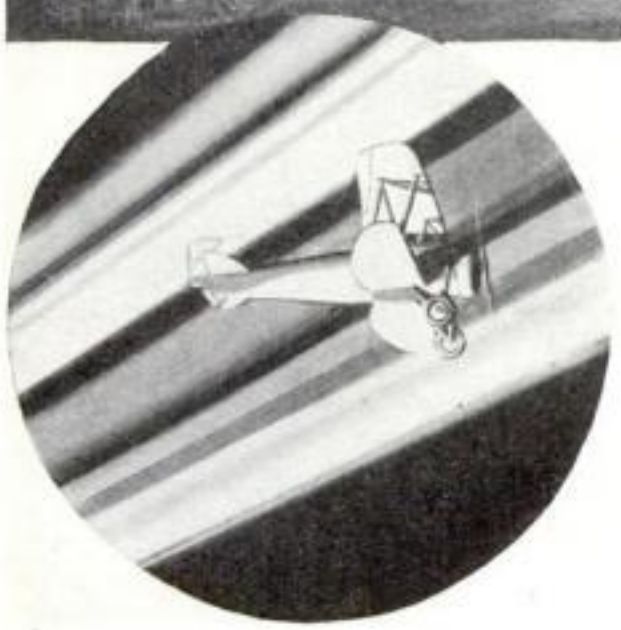


TEST MODEL PLANES IN HUNDRED-MILE GALE

HUNDRED-mile-an-hour gales rush through a 400-foot steel and reenforced-concrete wind tunnel recently completed at the Farnborough testing field, in England, and illustrated at the left. A 2,000-horsepower engine creates the artificial hurricane within the tube where models are tested.

Anti-Aircraft Searchlight Casts Nine Beams



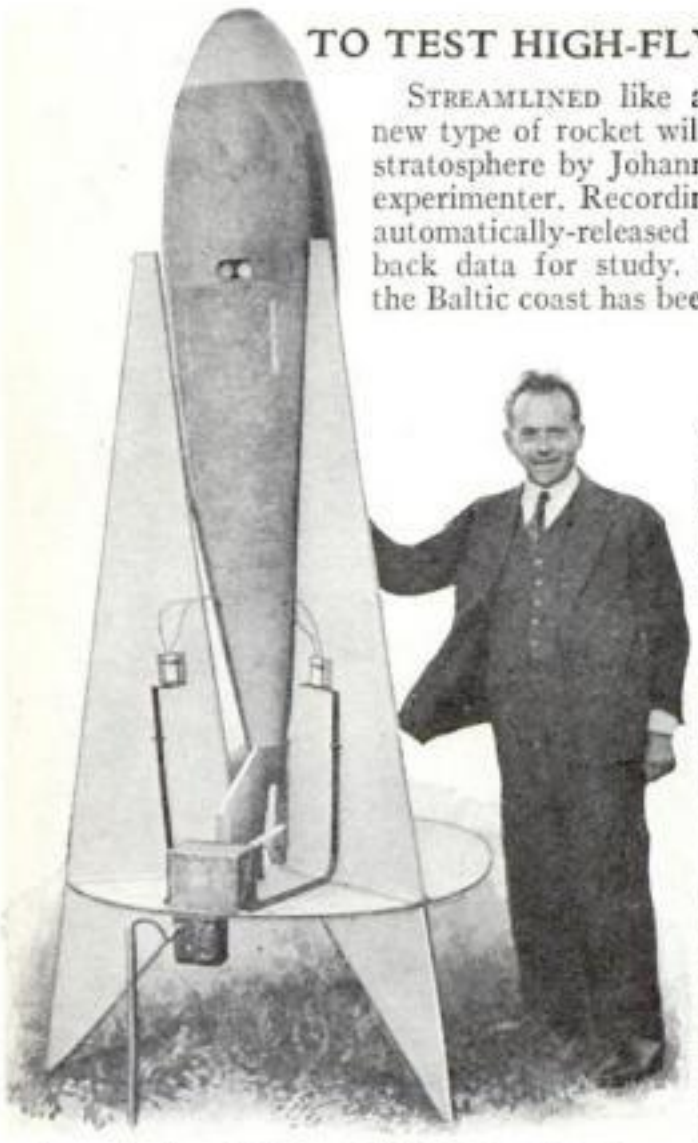


At right, new anti-aircraft searchlight with mirrors that break beam into nine separate parts, as demonstrated above. In circle, plane is seen caught in the multiple beams which, because of the angle of the mirrors, cover a wide section of the sky and make the escape of plane difficult

MILITARY officials at Fort Totten, N. Y., recently witnessed a demonstration of a radically new type of anti-aircraft searchlight. Hostile aircraft could hardly escape from its rays, since the main shaft of light is split into nine or more separate, high-intensity beams. This is accomplished by mounting a set of mirrors at an angle just in front of the searchlight. Each mirror rests at an angle slightly different from the others and casts a separate beam. Capt. A. M. Jackson, of the 62nd Coast Artillery, who invented the searchlight, has perfected the angles mathematically so no beam interferes with the rest. The searchlight employs a light source with an intensity of 800,000,000 candlepower. Gases and heat are removed with blowers.

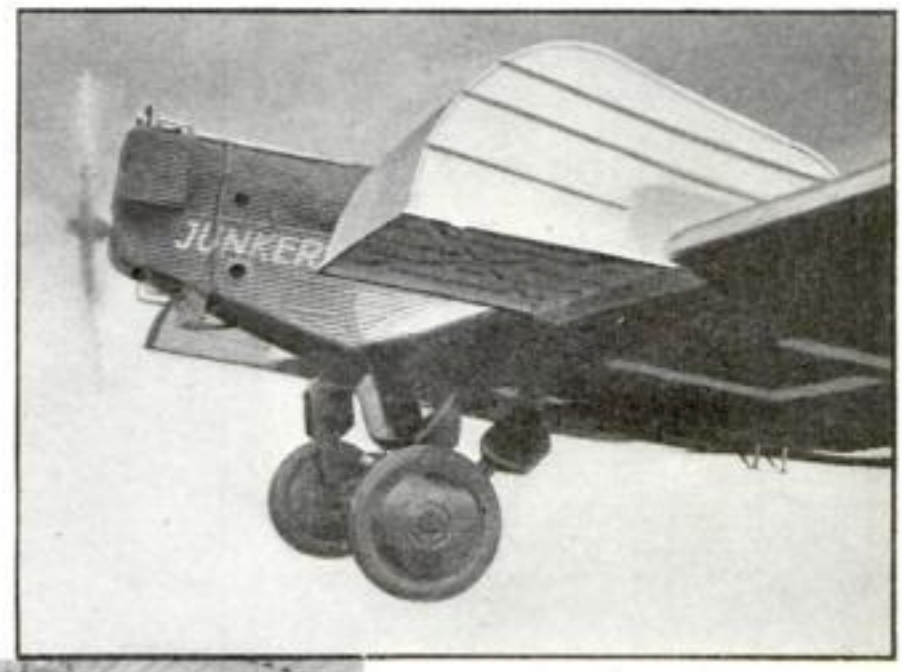
TO TEST HIGH-FLYING ROCKET

STREAMLINED like an airplane bomb, a new type of rocket will soon be shot at the stratosphere by Johannes Winkler, German experimenter. Recording instruments on an automatically-released parachute will bring back data for study. A lonely section of the Baltic coast has been chosen for the test.



Streamlined rocket for high-flying experiment

This rocket, with automatic parachute to return instruments with data, will be tested soon on Baltic coast in an effort to further study of stratosphere

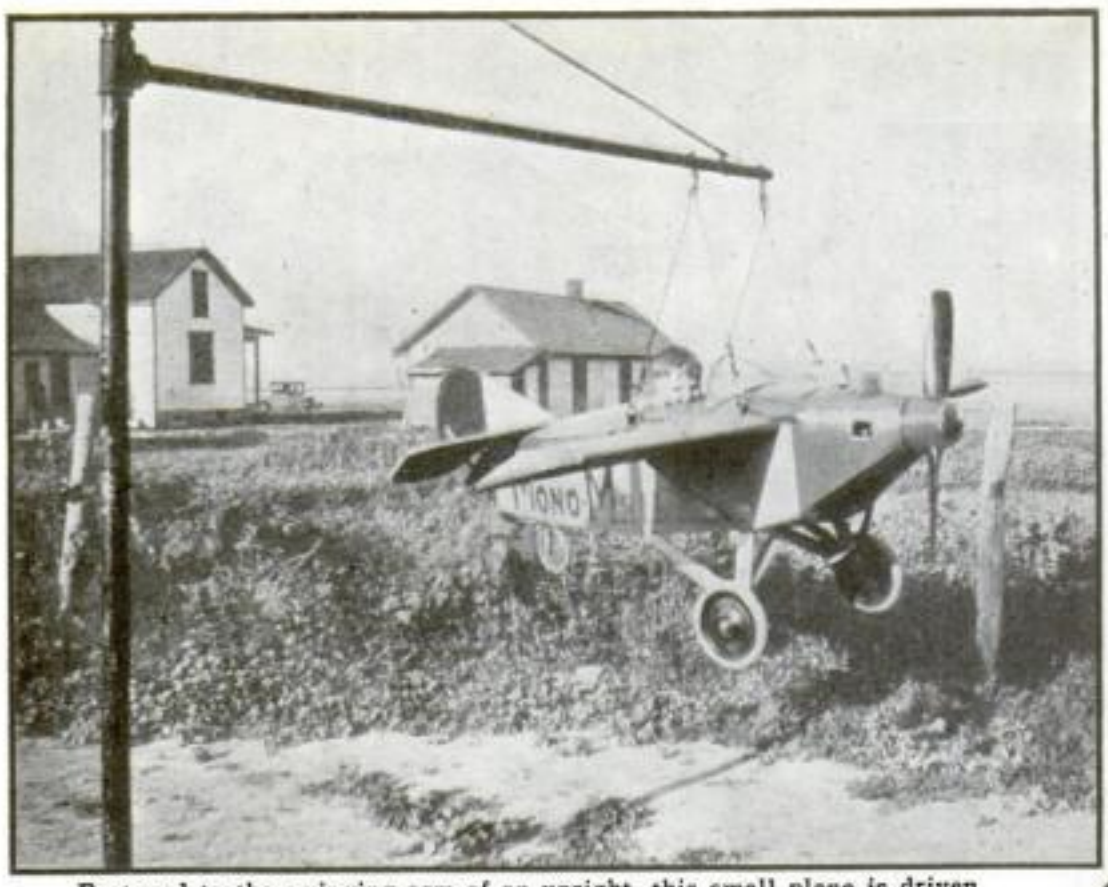


VOICE FROM PLANE HEARD FOR MILES

LOUDSPEAKERS often have been fitted to airplanes, so that a flyer may address a message to a crowd on the ground. So huge are the resonators in a new German plane designed for "sky-speaking," that they had to be built into the wings and aerodynamically shaped. It is said that, speaking from this plane in a low voice, one may be heard for miles.

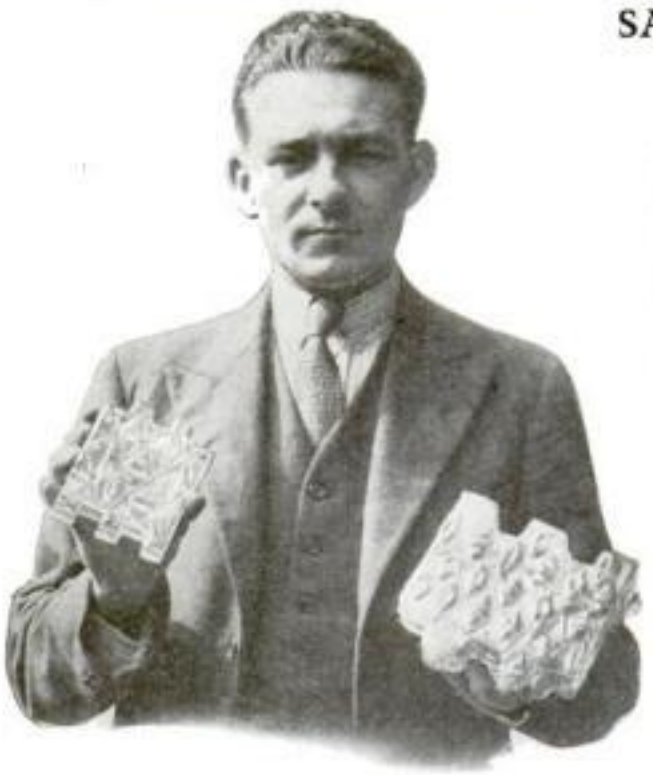
MOTOR DRIVEN PLANE FLIES AROUND POST

To AMUSE his small son, Fred E. Engler, of Pukwana, S. D., built a toy airplane that actually flies—or so it seems to its youthful rider. The model plane has a propeller that really runs, under the power of a small gasoline motor. It is hung like a swing, on cables, from a homemade standard. The supporting arm is a bar free to revolve. When the young pilot boards the machine and opens the throttle, the plane flies around and around the post at surprising speed. Thus the youngster gets all the thrills of flying with never a fear of a nose-dive or crack-up. Engler, as a spare-time hobby, has built several model airplanes, and powered them with gasoline motors so they fly short distances.



Fastened to the swinging arm of an upright, this small plane is driven by a motor at surprising speed around the post, while piloted by a boy

With this sacred pointer, an ancient South Sea navigating instrument, a modern ship was guided across Pacific



SACRED POINTER GUIDES SHIP

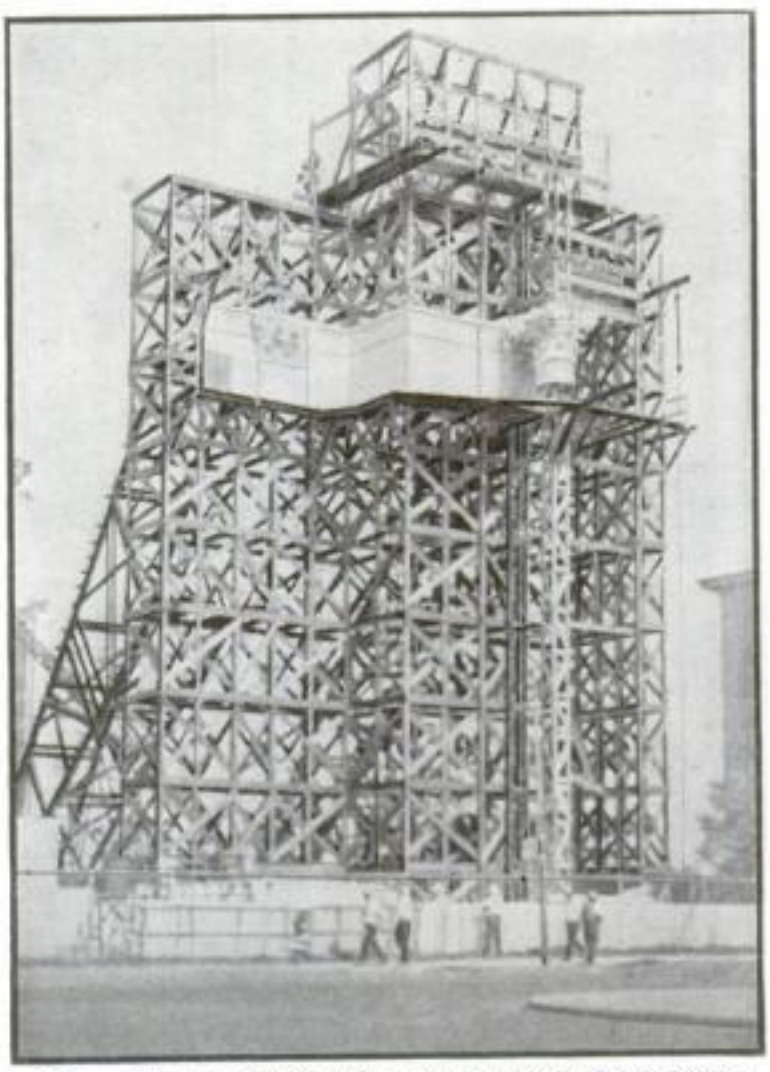
A MODEL of a "sacred pointer," ancient South Sea navigating instrument, was used recently to take star bearings during a Pacific voyage of the S. S. *Asama Maru*. Officers who made the odd test found the pointer surprisingly accurate, even though it necessarily could not compare with modern precision instruments. Centuries before the invention of the compass, South Sea islanders used such devices.

AUTO ROADS OF GLASS

MOST motorists will swerve to avoid a bit of glass lying in the road—but whole roads of glass are proposed by George J. Ricketts of London, England. According to his plan, interlocking "bricks" of glass would provide a smooth surface easily kept in good repair. Exposed faces of the bricks would be ribbed in a non-skid pattern. The photograph above shows the originator of the glass-road proposal, with two types of glass bricks.

PLASTER MODEL HELPS DESIGN BUILDING

WHEN the Franklin Institute in Philadelphia recently contracted for a new building to serve as its home, officials of the Institute and the city's Art Jury wanted to see in advance what the exterior would look like. So the contractor erected a wooden scaffold on the building site and displayed models in plaster of the building sections, at the height they would appear in the finished structure. Thus the future owners were able to be sure the finished building would be an artistic credit to the neighborhood.

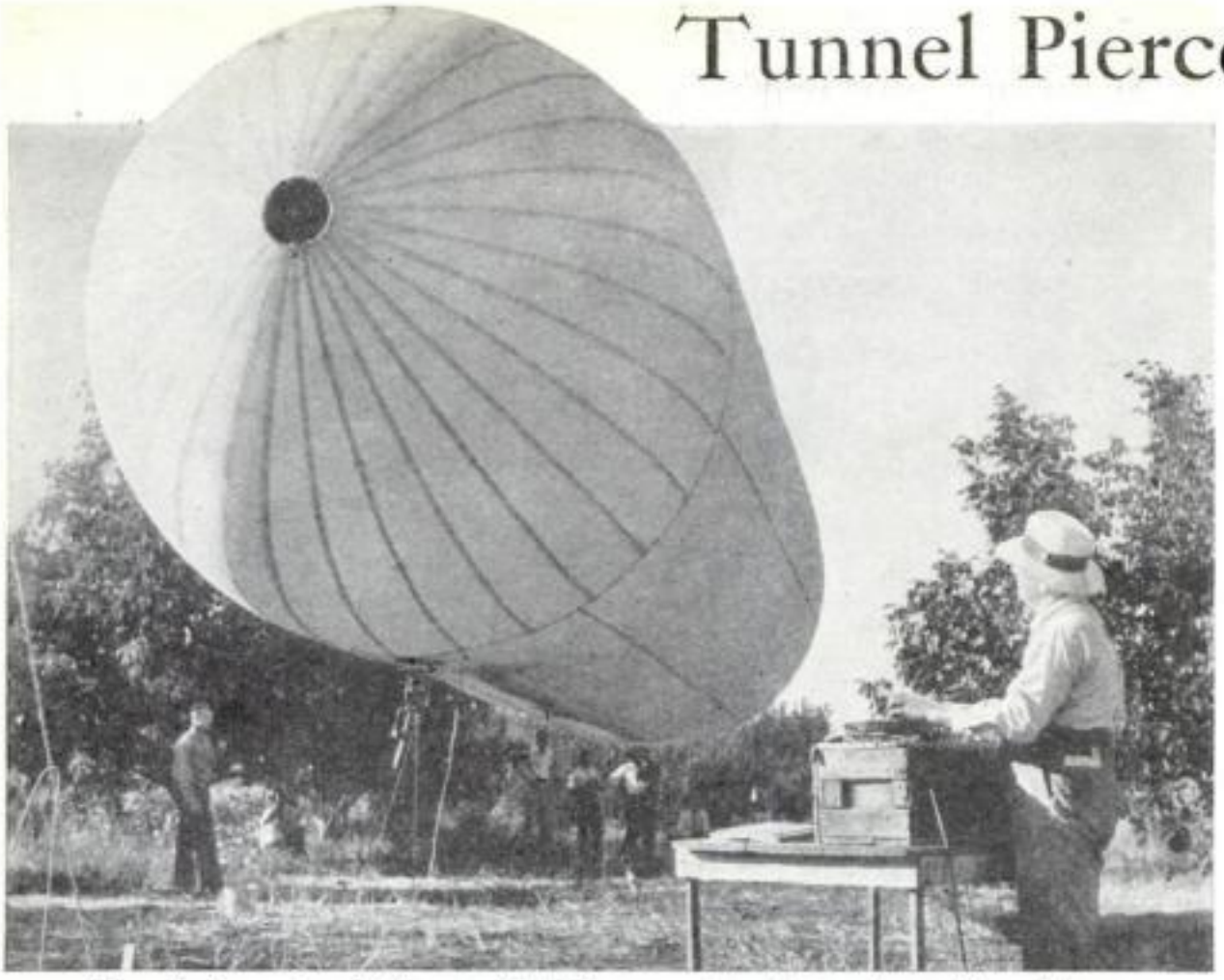


Mounted on a scaffold, this plaster model showed how a section of a proposed building would look when finished

EACH KEY HANDY IN THIS CASE

PULLING down a metal tab on a new key case brings all the keys out at the bottom, ready for use. An opposite motion withdraws them until further need. Held compactly and conveniently, they occupy little space in the pocket and cannot damage the lining of clothing while each key is in such a position that it easily can be used.

Tunnel Pierces New Airship



Through the center of this new dirigible runs a tunnel to reduce wind resistance

A THIRTY-THREE-FOOT model of a new style of dirigible was demonstrated at Van Nuys, Calif., the other day. An open tunnel pierces the entire length of the gas bag from bow to stern. The inventor, Thad Rose, believes that this will reduce wind resistance and increase the speed of the ship in flight. Two small electric motors ran the model airship's tiny propellers in the successful trial flights.

TALL CHIMNEY FALLS IN PERFECT BOW

WHEN a chimney of an abandoned German gas works was razed, not long ago, it made an unusual picture as it fell. Instead of breaking into two or three pieces as might have been expected, the stack bent and dropped to earth as a unit. A photograph snapped at the moment of toppling showed it as a perfect bow. A moment after the picture was taken, the fragments struck the earth with a deafening crash.

TINY RADIO SET WILL FIT IN POCKET

Now a pedestrian may tune in on his favorite radio program while he strolls down the street. A midget receiving set, exhibited at a recent English radio show, is so small that receiver and batteries may be carried in the pocket. The loudspeaker is contained in a hat. Possibilities of the novel set are not restricted to entertainment, for a special adaptation of it is reported in use by British police in receiving reports from a central station.

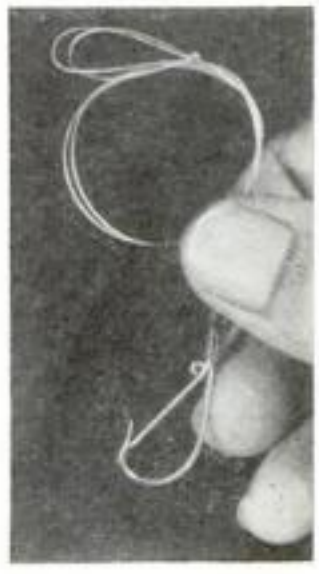
TYPICAL AMERICAN IS NO ADONIS

Typical American, modeled from 100,000 measurements of war veterans

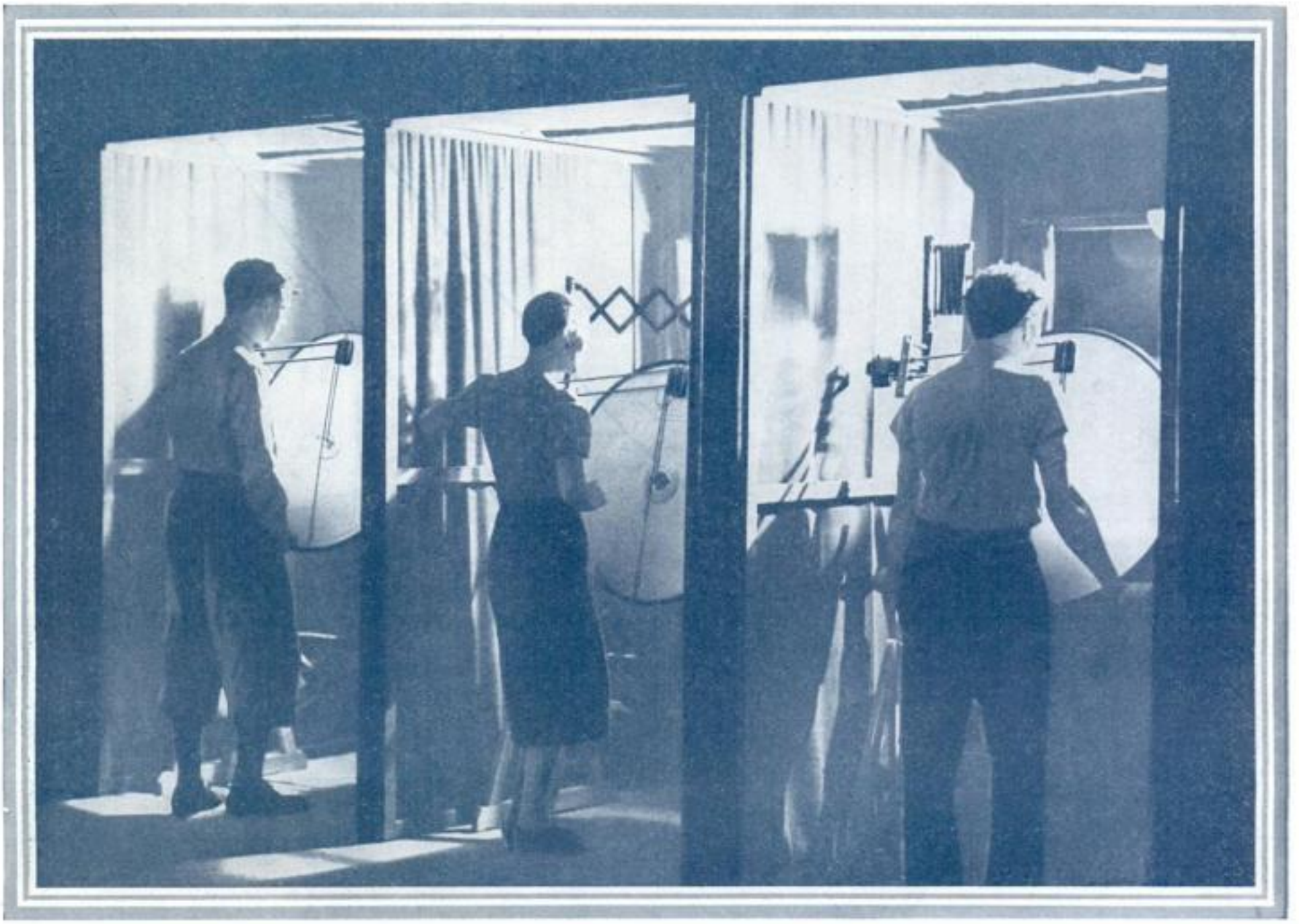
WHAT does the "average American" look like? To find out, a statue was recently modeled from the composite measurements of 100,000 U. S. war veterans, and exhibited in New York to an international meeting of experts in eugenics. It bears little resemblance to the Adonis of classical mythology, as portrayed by sculptors. The modern male is slight of build, with more development of his abdomen than of his shoulders. However, experts agree that this type of physique adapts him most perfectly to conditions of modern life.

NO BARB ON FISH HOOK

A BARBLESS fish hook just patented by a Johnstown, Pa., cabinetmaker, allows undersize fish to be removed and returned to the water without injury. Its spring grip resembles that of a safety pin. Caught in clothing, it is readily removed, and it is said not to snag easily in weeds or overhanging branches.



· New Art Fits Foreign

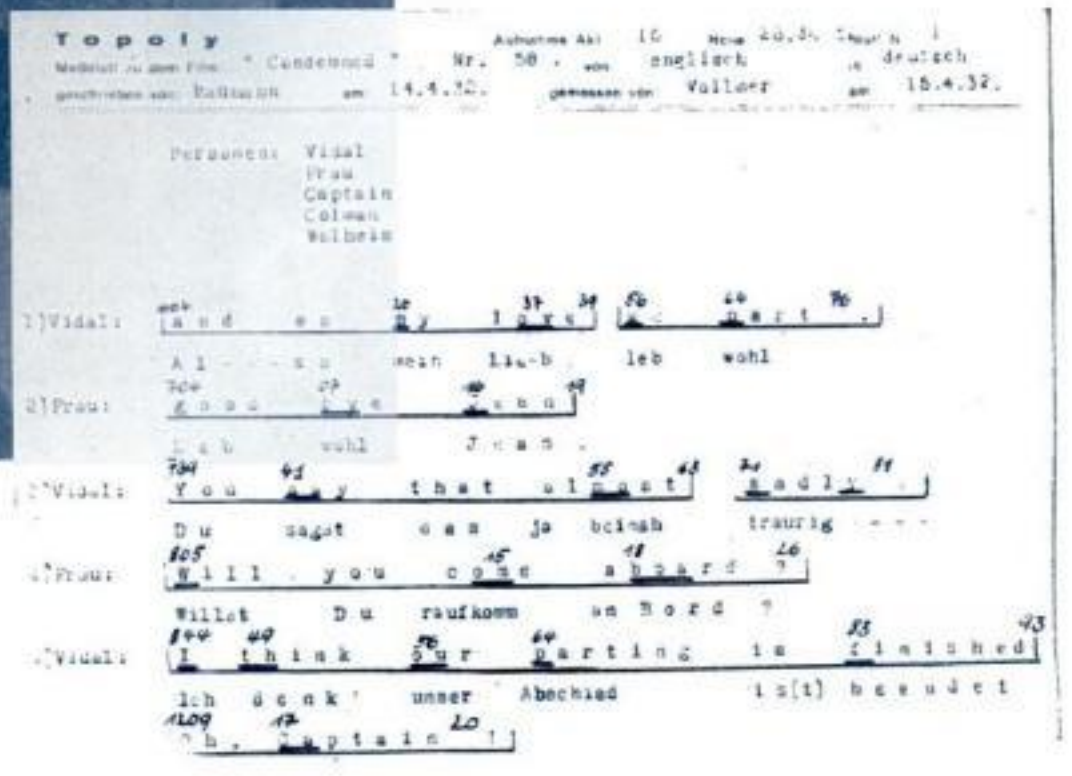


LIP MOVEMENT MARKED. After the original dialogue has been translated, the director, with translation in hand, slowly runs off the film, noting places where lip movements must be imitated and underlining the script for the actor

TRANSLATING ORIGINAL WORDS. Beneath the dialogue of the original, right, is written the translation, in this case from English to German. Note numbers above words, indicating a "frame" of the film, also that each version has same number of syllables

FITTING ON A NEW LANGUAGE.

In these cells, trained linguists speak the translated dialogue. Each actor is guided by a revolving disk marked so as to insure synchronization of sound and action and the right movement of the lips to fit the original picture



Speech to Any Film ·

RECORDING TRANSLATION. At left, the cells from which the translated dialogue is spoken, each performer being guided by a disk so the words will be spoken at the right time to fit the action in the picture

A REVOLVING DISK, to which is being transferred the translation, is divided into small spaces, each corresponding to a frame of the film. The actor later speaks each syllable as it appears beneath a tiny light

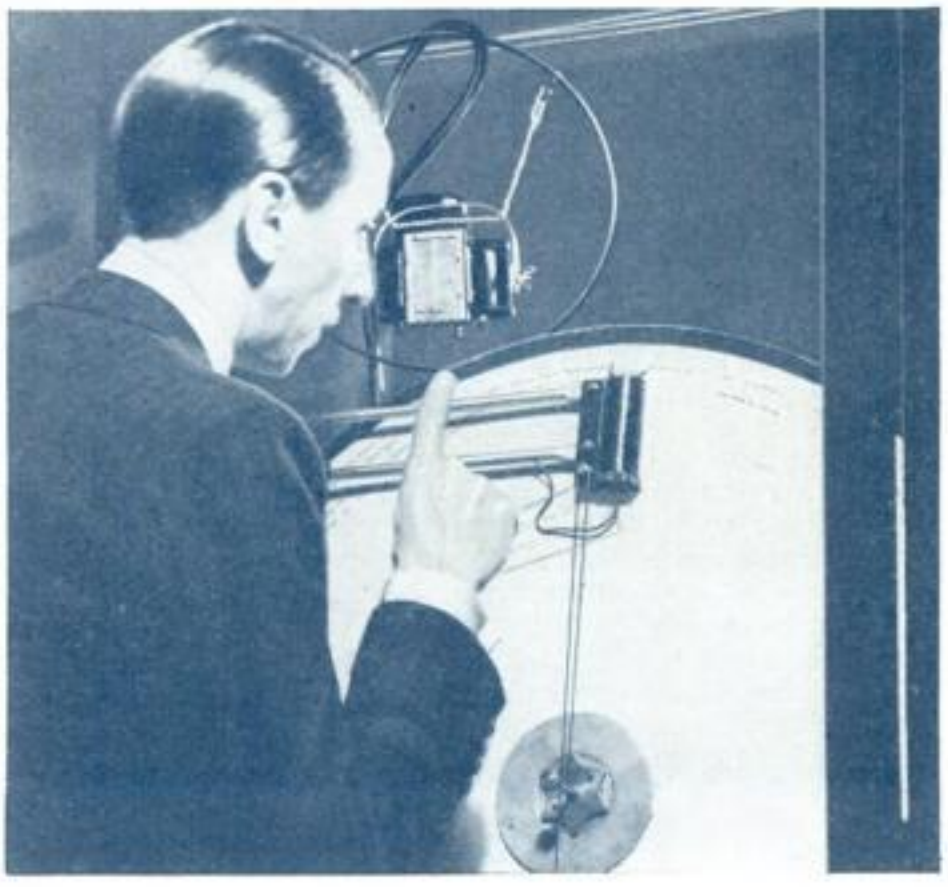
Talkies' Hardest Problem Solved by a Most Remarkable Process That Easily Replaces One Language with Another

LANGUAGES are being fitted like garments to actors in the talkies, these days, so that motion picture producers may send their films to foreign countries. An American movie goer may enter a Paris or a Berlin theater and find his favorite actor proposing to the leading lady in French, or discussing a business deal in German. A foreigner is likely to hear a star of his homeland perform in English, on an American screen.

This does not mean that the popular idols of the screen have suddenly acquired such mastery of foreign tongues that they can act in any language. Even if they could, the cost of filming so many versions would be prohibitive. Actually the dialogue that apparently comes so glibly from the actors has first been spoken by unseen "doubles."

Pictures on this and the preceding page, made in a German studio, show exactly how the process is carried out. First each "frame," or picture, in a film is numbered consecutively. Then an expert copies down the dialogue, noting against each word the number of the "frame" where it occurs. Next the text is translated. Syllables whose pronunciation requires distinct lip movements are underlined, for the translator in the foreign version must use equivalent words that are spoken with approximately the same movements. The completed translation is transferred to a disk that rotates before the actor-linguist, and tells him when to speak each word. Rehearsals follow, until all the "doubles" are ready to re-act the dialogue together on sound film. When this sound record is combined with a silent copy of the original film, the foreign version is complete.

When talkies came into style, it seemed at first an impossible task to change the whole dialogue for foreign presentation. Movie technicians, however, have conquered movieland's most difficult problem.



REHEARSAL COMES FIRST

To be sure they will speak their parts smoothly, the actors stand in front of the disks and rehearse their parts as the translated phrases appear before them

WHEN SOUND CAMERA WORKS

At left, view of an actor speaking the translated dialogue as disk, with pointer of light picking out the syllables, revolves slowly in front of him. This is the final step in putting a new language on the film without remaking the entire picture

TRICKS You Can

LEARNING A BACK FLIP-FLOP

This trick is taught by lifting the dog with the chain attached to its collar, while with the stick its hind legs are flipped into the air. In photo the dog's feet are just leaving the ground

TURNING A SOMERSAULT

In teaching a dog this trick, you must hold its head down with one hand, lift the body up and over with the other, at the same time giving the command, "Turn over." Food is given as a reward for good work

WALKING WITH WRONG END UP

To teach a dog to walk on its front legs, the head is held down with one hand and the hind quarters are raised with a stick. Only patient repetition will win out

STANDING ERECT LIKE A MAN

Learning to stand or walk on its hind legs is, next to sitting up, the easiest trick you can teach your dog. With a rope fastened to its collar, the dog is lifted erect and the front feet are tapped to keep it standing up

YOU can easily teach your pet dog tricks, according to the veteran showman, Henry B. Gentry, who has developed some of the most famous trained dogs in the country.

The first thing to do is to let the dog you intend to train live his own life for a year. Dogs less than a year old are too full of puppy ideas to take instruction seriously.

When he has reached the required age, teach him first of all to sit up. Do this by setting him on the ground, taking hold of his front feet and lifting him to a sitting position, at the same time snapping him gently beneath the chin with your finger and saying "sit up." Instead of snapping with the finger, you can tap him gently with a stick. The idea is not to hurt or scare him, but to persuade him to keep his head up. Some dogs will sit up at the command after being shown a dozen or so times. Others require much longer. The essential thing on your part is to be patient.

The second-grade stage consists of instruction in standing up. Put a collar on your pupil and attach a rope or chain. Then lift him until he is standing upright on his hind feet. At the same time tap his front feet with a stick, just hard enough for him to feel it. Don't be afraid of injuring him by lifting with the collar, for there is no danger of choking if you do it carefully. This trick is a little more difficult than sitting up, as a dog finds it harder to balance himself on his hind legs alone, but he will soon master it.

The simple somersault may be taken as the next logical step in your dog's education. It is not easy because a dog objects to holding his head down. So you must put him through the routine over and over by hand. With one hand hold his head to the ground while with the other you lift his body up and over, at the same time teaching him some such command as "turn over."

Next you may as well take up the back somersault which is performed in the air —really a backward leap. Equip the dog with a collar and rope, and obtain a stick. A thirty-six-inch length of dowel rod is excellent. Put the stick under the dog's front legs, lifting upward on it, and at

Teach Your Dog

Veteran Trainer Describes Stunts Your Pet Can Easily Acquire—if You Use Enough Patience and Time

By WALTER E. BURTON

BALANCING ON A ROPE.

Teaching a dog to stand up on a slack rope is difficult but it can be done and the three steps in acquiring the trick are illustrated above. First, the dog is taught to climb, unaided, onto the rope. Second, the dog learns to balance itself on the rope on all four feet. Third, the trick is learned when the canine pupil is able to stand on its hind feet and maintain its balance on the rope

the same time jerking the dog up and over with the cord. This may sound a bit rough on the pupil, but circus trainers have not found it so. This trick is the hardest one so far, but is particularly effective when performed.

Walking on the front feet is, for a dog, not easy. Place your training stick under his hind legs and lift him to a vertical position, at the same time holding his head down with your other hand. Then keep him upon his front feet by tapping his hind legs with the stick, hard enough for him to feel it.

THE jumping rope trick is a good one to show visitors. Arrange a rope that can be whirled around, and put a collar and cord on the dog. Then place the dog over the rope, start turning it, and lift him up by the collar each time it comes around. At first, the dog will move sidewise in an attempt to get out of the way of the rope; but soon he will learn to jump upwards. Instead of a whirling rope, you can use a stick, swinging it around in a circle for the dog to jump over.

There is another rope trick that may be regarded as a post-graduate stunt. In performing it, the dog climbs on a slack rope and then stands upright on his hind feet. A rope an inch or more in diameter is used. First teach the dog to stand upright on the ground. Then put him on the rope and work with him until he can balance himself on all four feet. Next coach him in standing on his two rear feet only, a stage made easier by his knowledge of how to stand upright on the ground.

There are, of course, countless other tricks that your dog can be taught. But this collection will be found adequate for the average canine performer.

There is one important thing that no dog trainer overlooks. That is the reward. A generous allowance of hamburger or a dog biscuit at the conclusion of each lesson or after the successful performance of a stunt will go a long way towards assuring success. Circus dogs are liberally rewarded while being trained, but are not paid during an exhibition as that would lower the effectiveness of the acts from the viewpoint of the spectator.

Probably you have noticed that dog trainers at the circus always carry whips. In making as many as forty energetic dogs cooperate in giving a performance, the whips are needed to keep the performers from fighting or clustering around the director and spoiling the act. However, the dog lover who is attempting to teach his solitary pooch a few choice stunts will find no need for a whip and probably will get along better without it.

A TRAINED dog's active life is usually from ten to twelve years. Among circus men, the favorite performing dogs are fox terriers and collies. The spitz, the greyhound, and one or two other breeds are comparatively easy to train and mongrels sometimes make star performers. Poodles are very much in evidence in circus dog troupes, even though most members of the poodle family are boneheads when it comes to learning tricks. However, when a poodle can be taught, he makes an excellent actor.

It is difficult to understand why more dog owners and dog raisers do not spend a few minutes each day teaching tricks to their pets. In addition to knowing how to perform his collection of tricks, an educated dog does everything else more intelligently, and his cash value is much higher. A well-trained circus dog is worth his weight in gold and a troupe of dogs, trained to cooperate in their performance at their master's command, is priceless.

RADIO *and* DYNAMITE

Two miles away, 2,000 sticks of dynamite are ready to be exploded. Pressing the button of the detonator, above, in the prospector's truck, sets off the blast. Sensitive instruments, right, record the time the sound of the explosion arrives and thus reveal nature of hidden rock

FORTUNES in zinc ore today are shipped to Europe from enormous deposits in Newfoundland where, five years ago, not an ounce of ore was being mined.

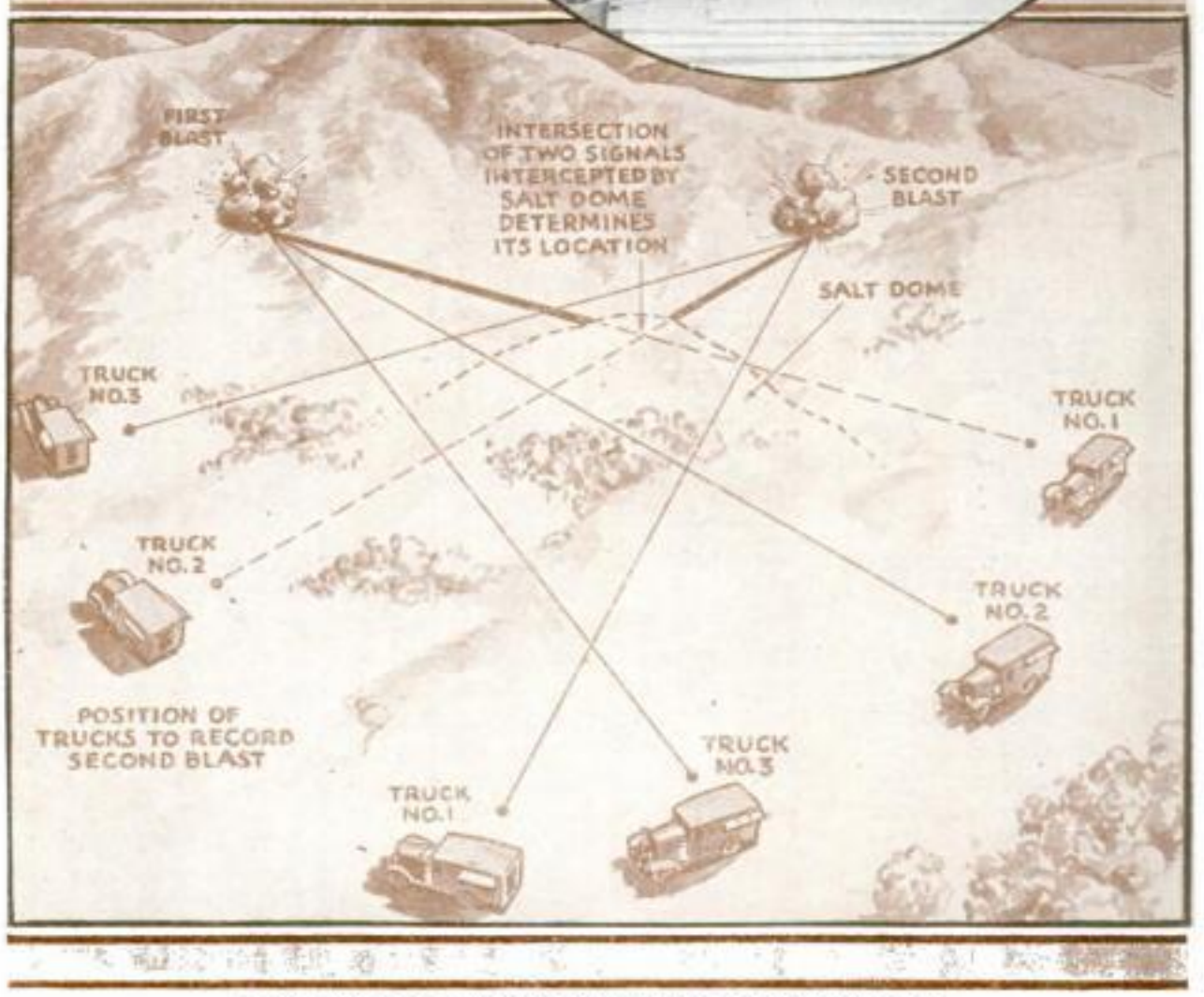
For miles around, the territory, including the now famous Buchans Mine, belonged to the late Lord Northcliffe, British newspaper publisher, who had bought the land for the sake of its paper pulp forests. One day, an Indian, fishing with a net in a river, hauled up a strange looking "rock." It was zinc ore.

Northcliffe immediately called in geologists whose tests showed the ore would be too costly to work. The thin vein was estimated to contain about 100,000 tons. Northcliffe refused to get excited.

In 1927, another party of experts visited the region. Equipped with electrical prospecting instruments, they made a sensational discovery. Back from the river, the country was covered deeply with gravel deposited ages ago by a great glacier. This gravel bed, concealing two huge bodies of zinc ore, contained nearly 6,000,000 tons!

Lacking modern apparatus, that vast store of riches might have gone undetected for generations. The second group of experts represented a new type of treasure hunter who, by the magic of the latest scientific methods, now makes the earth reveal its hidden wealth. Their tests were successful because they resorted to the science of geophysics.

What the X-ray is to the physician, geophysics is to the prospector. It enables him to probe deeply into the earth without the dangers, toil, and expense of excavation. Delicate electrical machines, by measuring the strength with which electric currents flow through the earth, reveal conditions below the surface. Dry rock



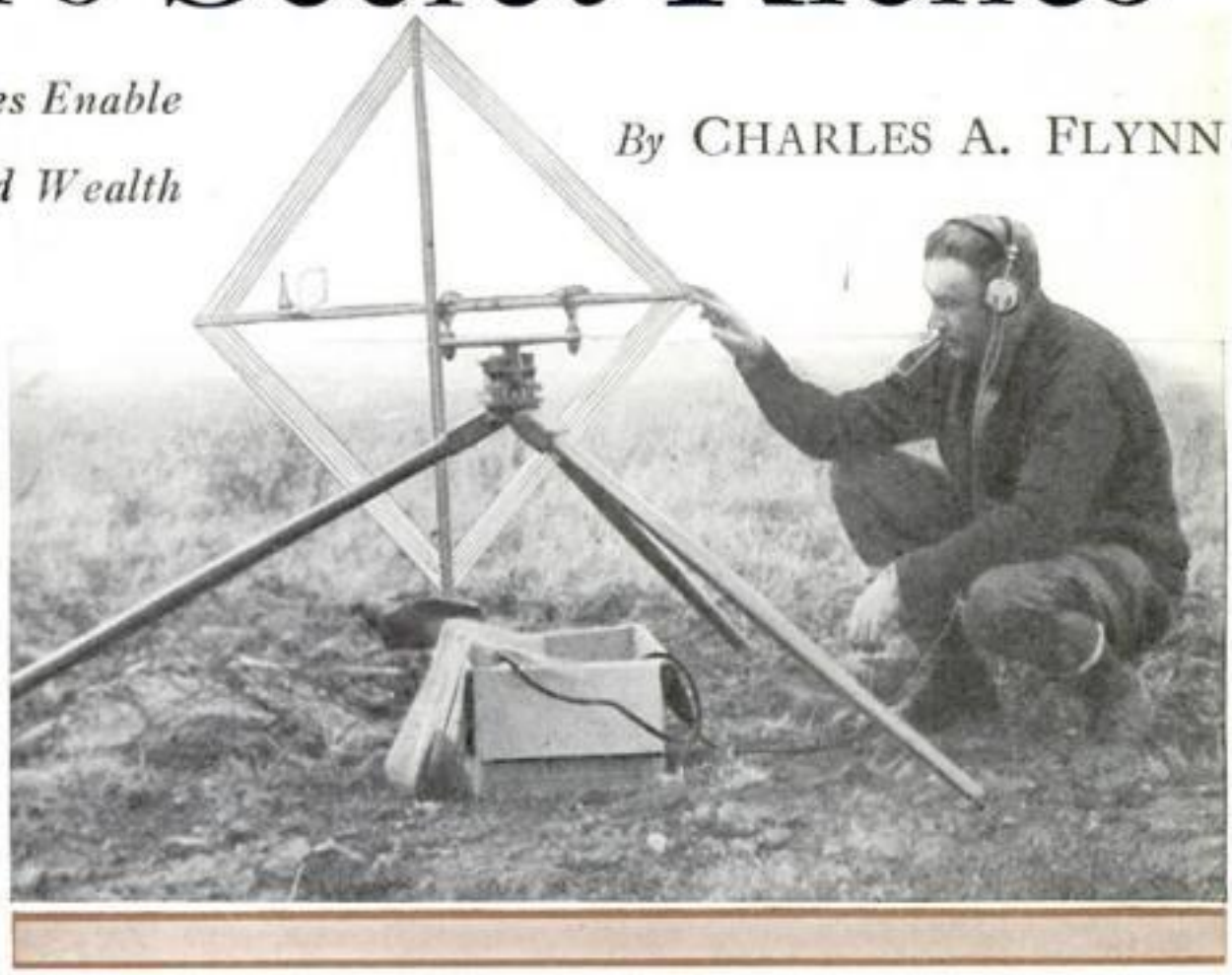
HOW DEEPLY BURIED SALT DOME IS MEASURED

Diagram showing how trucks are placed and explosives detonated in order to discover the exact size and location of a salt dome which may lie thousands of feet beneath the earth's surface. By "shooting a profile" of the dome the prospectors find where the unseen field begins and ends

find Earth's Secret Riches

New Miracle-Working Machines Enable Experts to "See" Deeply Buried Wealth

By CHARLES A. FLYNN



A radio receiving loop is part of the modern prospector's equipment. It is set at right angles to source of blast and if no sound reaches it, the waves have been deflected, probably by an oil field lying thousands of feet below the earth's surface

This graphic drawing shows how sound travels from explosion point and is reflected from the various strata of the earth's crust to instruments in the truck. White line shows breaks at points where tremors shook the seismograph

offers great resistance to the flow of electrical current, while many metallic ores, being highly conductive, show only slight resistance. Through these variations, trained men ascertain the presence or absence of minerals.

That was the process used in Newfoundland. Only recently, a Norwegian mining engineer made the startling announcement that, by the same means, he had located gold in northern Scandinavia where no gold was known to exist.

This so-called electrical resistance method is only one of many items in the amazing bag of tricks the geophysical prospector brings into play to discover mineral wealth. Instead of electrical currents, he may use radio waves to detect metallic ores, including gold and silver. A compass needle will find magnetic iron and oil-bearing rock. Remaining on the surface, he weighs the lower layers of the earth's crust with the "torsion balance," a bulky but delicate instrument that measures the increased pull of gravity in the vicinity of heavy ores and oil-bearing rock, thus determining the presence of such deposits.

The spinthariscope (P.S.M., April, '32, p. 124) tells him whether ores contain the world's most precious substance, radium. By means of a process resembling, in principle, that of the sonic depth finder which seamen use to measure the ocean's depth, he causes "elastic" sound waves to travel thousands of feet into the earth and to bounce back, revealing the presence of deep-lying fields of oil.

For the same purpose he more often adopts the "seismic" method of prospecting which, as the name implies, involves creating artificial earthquakes by the discharge of dynamite. The extent to which this work is carried on in this country is indicated by the fact that 3,000,000 pounds of dynamite are being used annually in seismographic explorations in three of the great oil basins in the United States.

Reduced to its simplest terms, the method consists in staging a race between a radio wave and a shock, or seismic wave. This is the way it is done:

A charge of dynamite, sometimes as large as 500 pounds, is buried in the ground. Around the explosive is wrapped one wire of the antenna of a portable radio transmitter that sends out a sustained note. From two to five miles away, there are three trucks, spread out fan-shape, equipped with sensitive recording instruments. One of these is a special radio receiving set that casts a spotlight ray on a moving film as long as the broadcast sound comes in. The instant the dynamite explodes, breaking the antenna wire, the radio signal cuts off and the line on the film comes to an abrupt end.

Below this line is another formed by the reflected beam from a seismograph's mirror. It is straight until the shock of the explosion, running through the ground, reaches the truck and jiggles the mirror, thus producing a jagged line. The film is divided by vertical lines into spaces representing hundredths of an inch. The number of spaces from the end of the radio-produced line to the beginning of the jagged line, indicates the exact time between the explosion and the arrival of the tremors. As the distance traveled is known, the rate of speed is easily computed.

Through ordinary earth, a ground tremor passes at the rate of about 6,000 feet a second, but through domes of salt which, in oil field regions indicate the presence of oil, it speeds up to about 16,000 feet a second. If the record made by one of

the trucks shows the tremor came at a speed greater than 6,000 feet a second, the investigators suspect the presence of a salt dome somewhere along the line. To make sure, they begin "closing in!"

The first step is known as "cross-fanning." On one side of the line the trucks are spread out again in a fan shape while a charge of dynamite is set off a mile or so on the other side. If one truck gets the tremors in advance of the others, a line between this listening post and the blast is drawn on the map. Where this line bisects the first one is the position of the dome.

Before drilling begins, a final test, called "shooting a profile," is made. On a straight line between the dome and the dynamite, the trucks are placed in a row and then moved along across the dome, making records of successive blasts. These records break up the territory where the dome is located into small sections and give the speed of the tremors through the earth in each. Thus, the investigators can determine just where the dome begins and ends. Also, by proving the tremor-speed is 16,000 feet a second, exactly that found in rock salt, they know absolutely the formation below their feet is a salt dome and that it is quite likely they have struck oil.

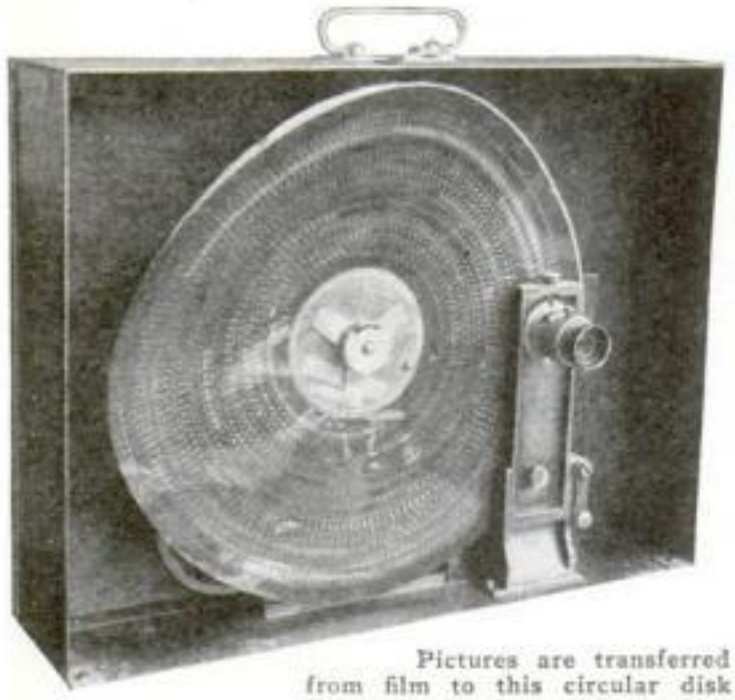
Prospectors bury dynamite sticks and detonate them with an electric key in mapping strata of the earth's crust

A successful device for locating oil wells is a metal "ear," the invention of Frank Rieber, Los Angeles, Calif., physicist, who has sought and found oil in many fields in the western and southern parts of the United States. Weighing ninety pounds, the amazing apparatus is so sensitive that, buried under three feet of ground, it can "hear" the vibrations caused by two blades of grass slapping together 200 feet away! Because it measures directly the speed of waves traveling through the ground when dynamite is discharged, the "ear" takes the place of the seismograph. With it, Rieber often has heard "elastic" waves from dynamite explosions bump against the hard roof covering oil-bearing rocks, and bounce back to the surface.

The ear consists of a cylinder ten inches in diameter, containing a solid iron mass balanced nicely upon a single quartz crystal, which rests on the bottom of the cylinder and thus, in effect, on the earth when the instrument is buried. When an explosion sends its wave train hurtling toward the ear, the wave squeezes the crystal against the iron mass, creating at that instant the so-called piezo-electric effect, which generates a tiny electrical current. This is used to record, on photographic film, the time of the arrival of the wave, from which its speed is computed with ease and accuracy.

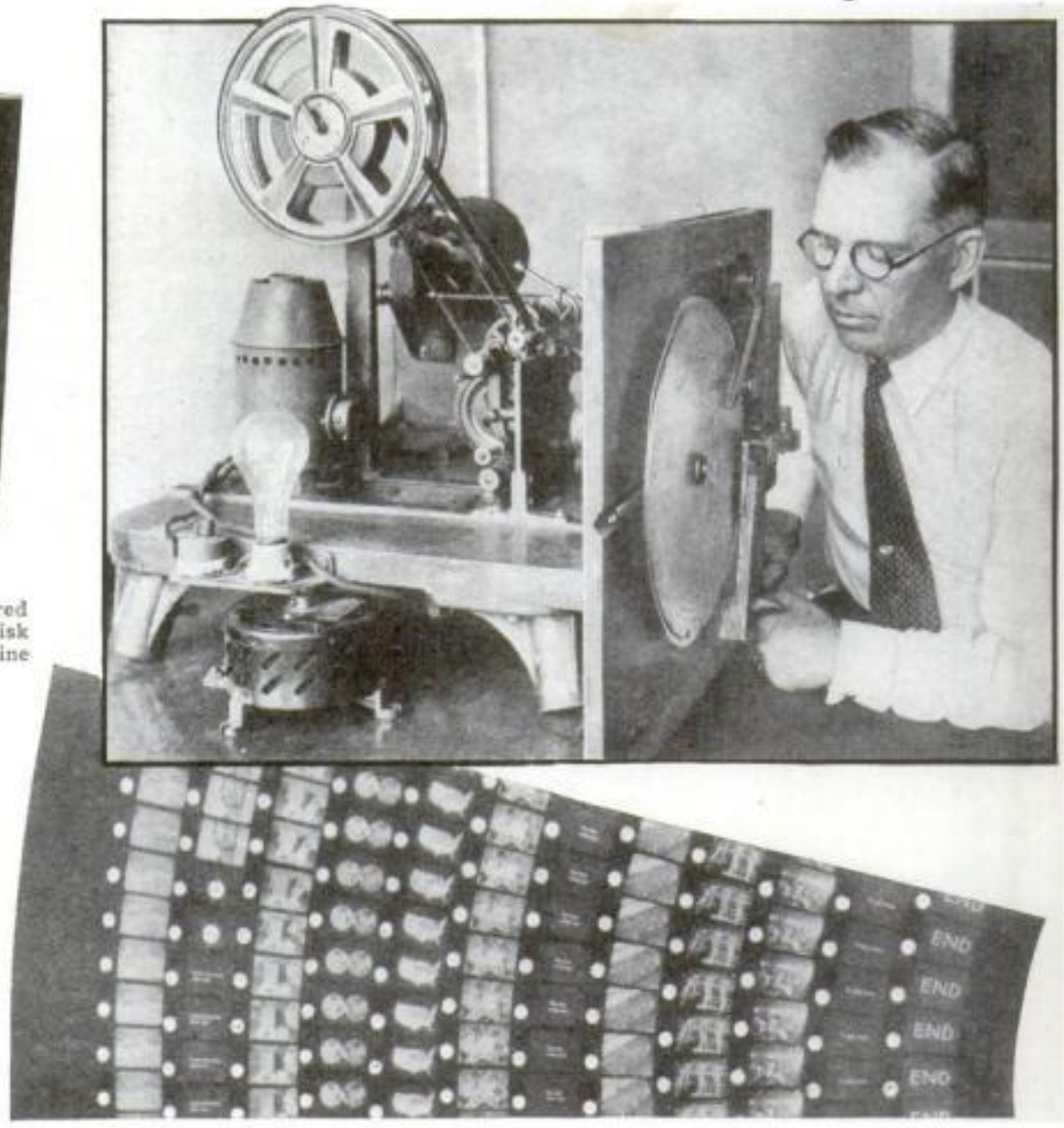
To prevent the ear from receiving and recording *(Continued on page 112)*

Disk Replaces Movie Film in New Projector



Pictures are transferred from film to this circular disk for projection by a new machine

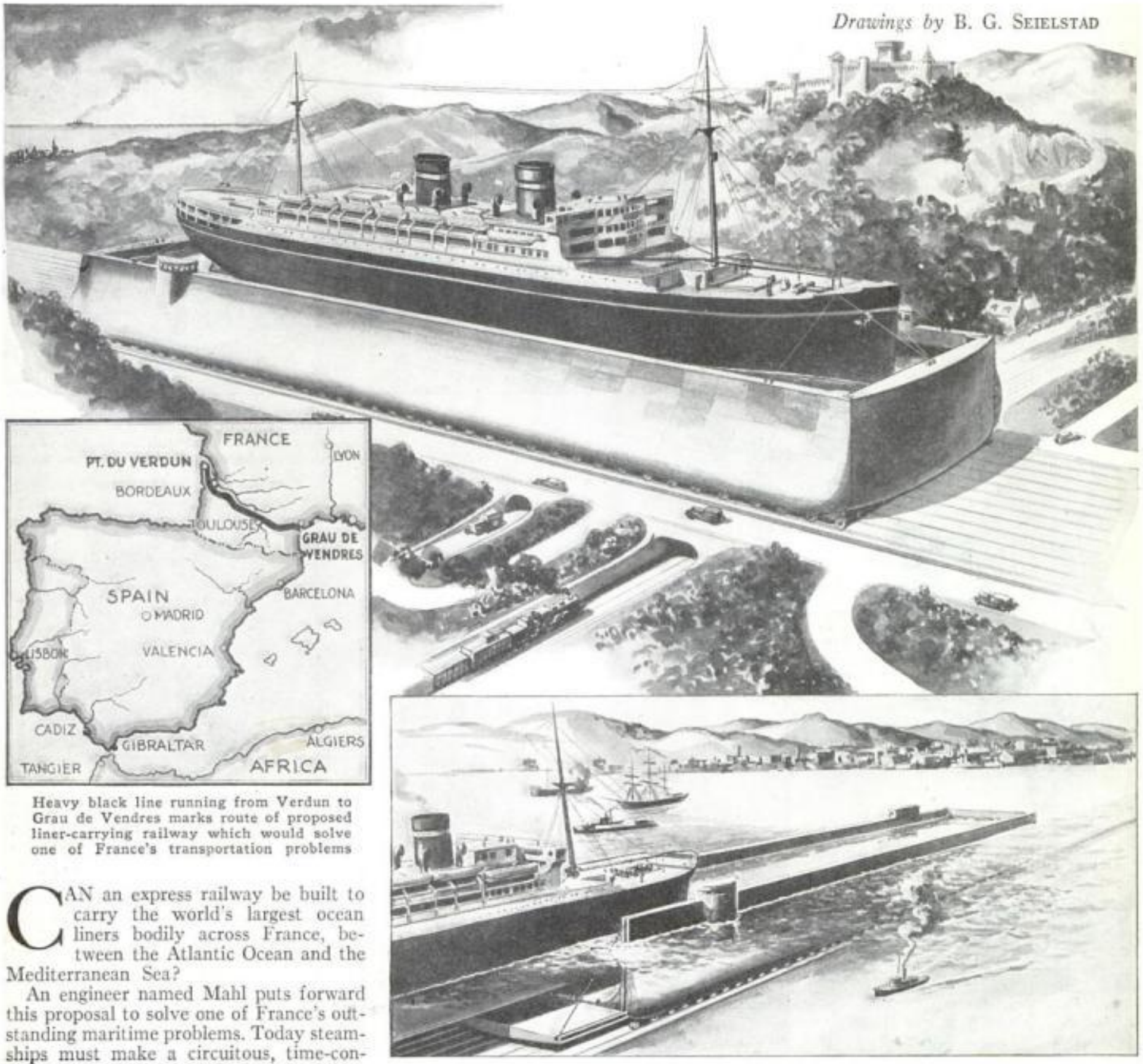
CIRCULAR film disks replace standard film in a new motion picture projector, designed for educational and advertising use. According to the inventor, the disks are far less fragile than ordinary film and can be projected 10,000 times without breakage or other damage. The apparatus includes a special printing machine to transfer the pictures from conventional film to the sensitive emulsion of the eighteen-inch disks. In their new form, the pictures are arranged in a spiral leading from the outer edge to the center of the disk. The images are so reduced in size in the printing process that each disk takes the place of 1,000 feet of ordinary film.



At top, a special printing machine is at work transferring pictures from movie film to round disk. Above, close-up of section of one of the film disks, showing spiral arrangement of frames

Giant Railway for Ocean Liners

Drawings by B. G. SEIELSTAD



Heavy black line running from Verdun to Grau de Vendres marks route of proposed liner-carrying railway which would solve one of France's transportation problems

CAN an express railway be built to carry the world's largest ocean liners bodily across France, between the Atlantic Ocean and the Mediterranean Sea?

An engineer named Mahl puts forward this proposal to solve one of France's outstanding maritime problems. Today steamships must make a circuitous, time-consuming journey around Spain to get from one body of water to the other. So often discussed and debated that it already has a name, "The Canal of The Two Seas," is a long-cherished French project of a deep waterway between the country's two coastlines. Mahl's bold alternative would obviate the need of such a canal. His ship-carrying railway, he declares, could be constructed at half the cost of the canal.

"Cars" for this amazing railway would be giant reservoirs of water rolling upon trucks—literally, "canal locks on wheels" as the inventor describes them. Each would hold enough water to float a vessel twice the size of the *Ile de France*. According to the inventor's plans, the car will be provided with ten axles, each bearing twelve wheels rolling upon rails nine feet apart and embedded in concrete. The total length of the car is 650 feet, or nearly three city blocks.

The projected route of the railway is between the point of Verdun, on the Atlantic coast, and Grau de Vendres, on the Mediterranean—a distance of about three hundred miles. At each terminal, an inclined extension of the railway will run down into the water. When a liner wishes to be transported, and the fee for passage has been paid, one of the reservoir cars will descend the inclined rails until its wheels are well below the surface of the water. A swinging bascule door at the forward end will be open during this process, allowing water to enter the car. The liner is then maneuvered by tugs into the car. The bascule door is closed and made watertight. Slowly the car remounts the incline with its massive burden of water and ship.

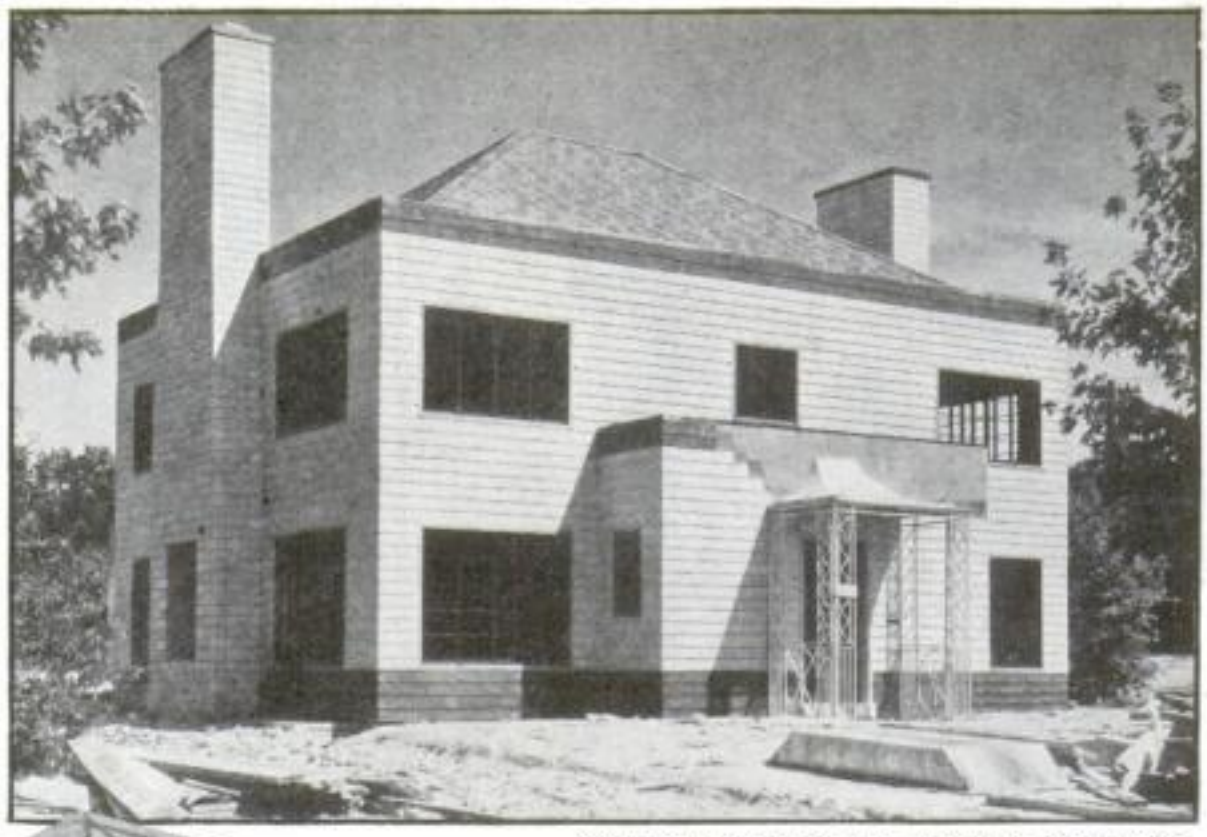
Once on level ground, the car moves across country under the impulse of its self-contained electric motors at a speed greater than that possible to ships in a canal. When it arrives at the destination, the liner is set down in the water by reversing the process used in picking it up. Again the bascule door swings open, and the vessel steams out and on its way.

To build more than one of the big tracks required by this giant railway would be of prohibitive cost. Therefore turn-outs will be constructed at certain points along the right-of-way, where one of the cars can be shifted laterally off the track to allow the passage of another going in the opposite direction.

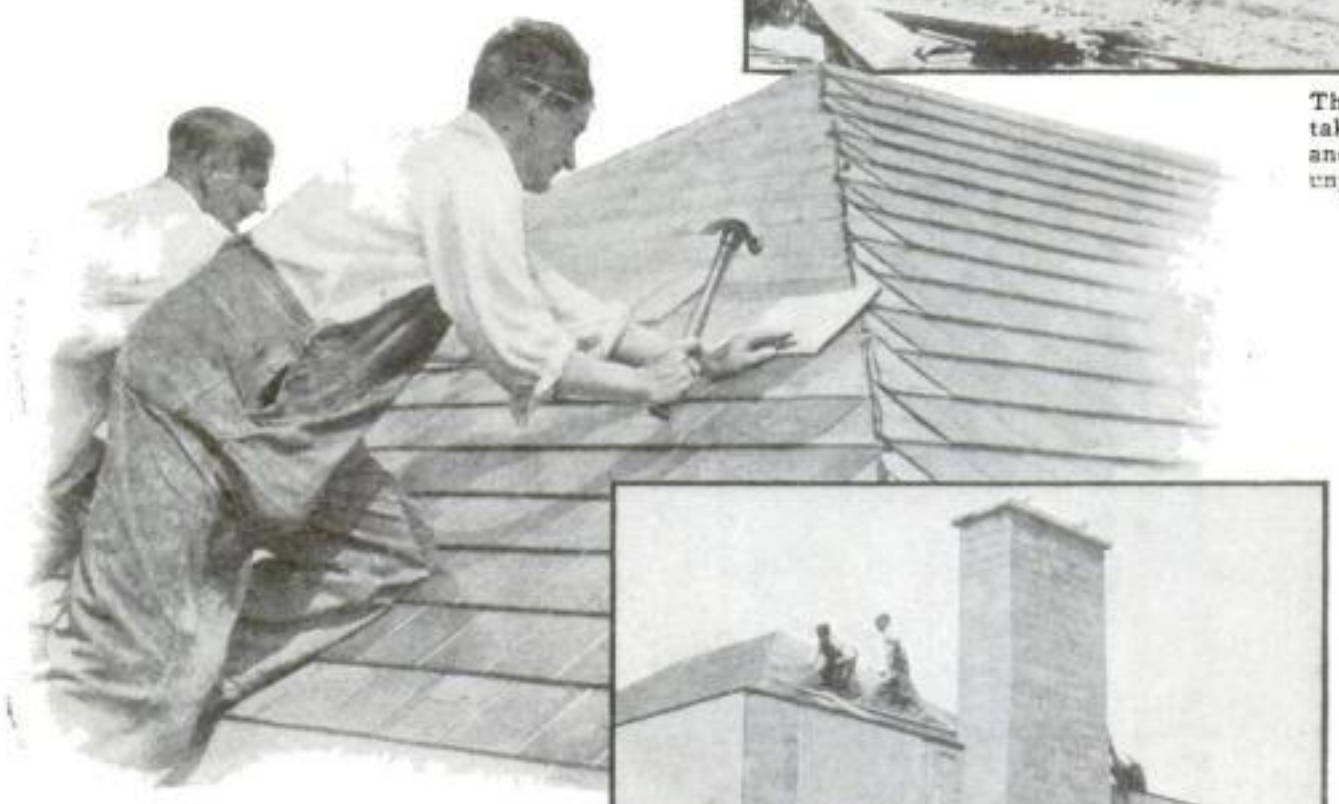
Despite the boldness of Mahl's plan, it has captured the attention of engineers seeking a solution to France's waterway problem. In its favor is pointed out the immensity of the task of building such a canal as has hitherto been proposed—a "big ditch" that would have to be nearly ten times as long as the Panama Canal.

Drawing suggests manner in which the gigantic railway cars would take on board ocean-going vessels and rush them across France from the Atlantic to the Mediterranean in a few hours

Here's *the* World's *First* Porcelain House



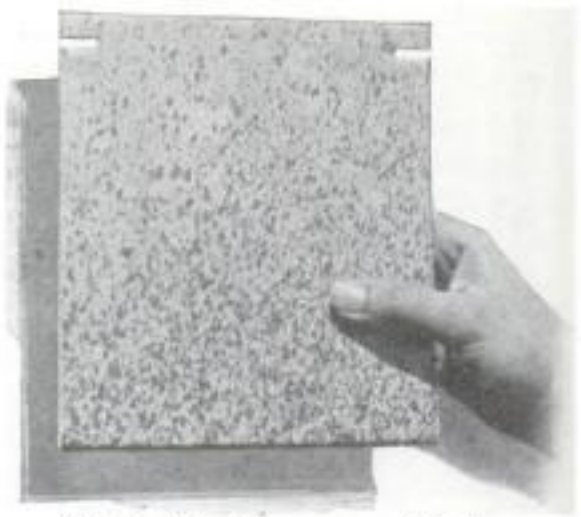
This picture of the first porcelain house was taken just before it was finished. Walls, roof, and chimney are covered with the enamel which, unpainted, can be cleaned with soap and water



Laying russet colored porcelain shingles of dull finish on the roof of this porcelain house, just built in Cleveland

Mineral wool and fiber board were laid over steel to insulate the house from heat and cold

Welding together the steel frame work that supports the porcelain house. Only three weeks were required to put up the framework for the two-story house and a big garage



Shingles like this were used on the porcelain building. The enamel, laid on a backing of steel, is thoroughly durable

IMAGINE a home that costs little to build, never needs painting, and requires only soap and water to keep its exterior clean—and you will have a good idea of the world's first "porcelain house," which has just been completed at Cleveland, Ohio.

Buff-colored walls of this eight-room dwelling present a spotless surface. They are covered with shingles of porcelain enamel, on steel backing. Roof and chimney are similarly finished in porcelain. Should the idea capture public fancy, it may set the style for one of the most startling innovations in architecture in recent years.

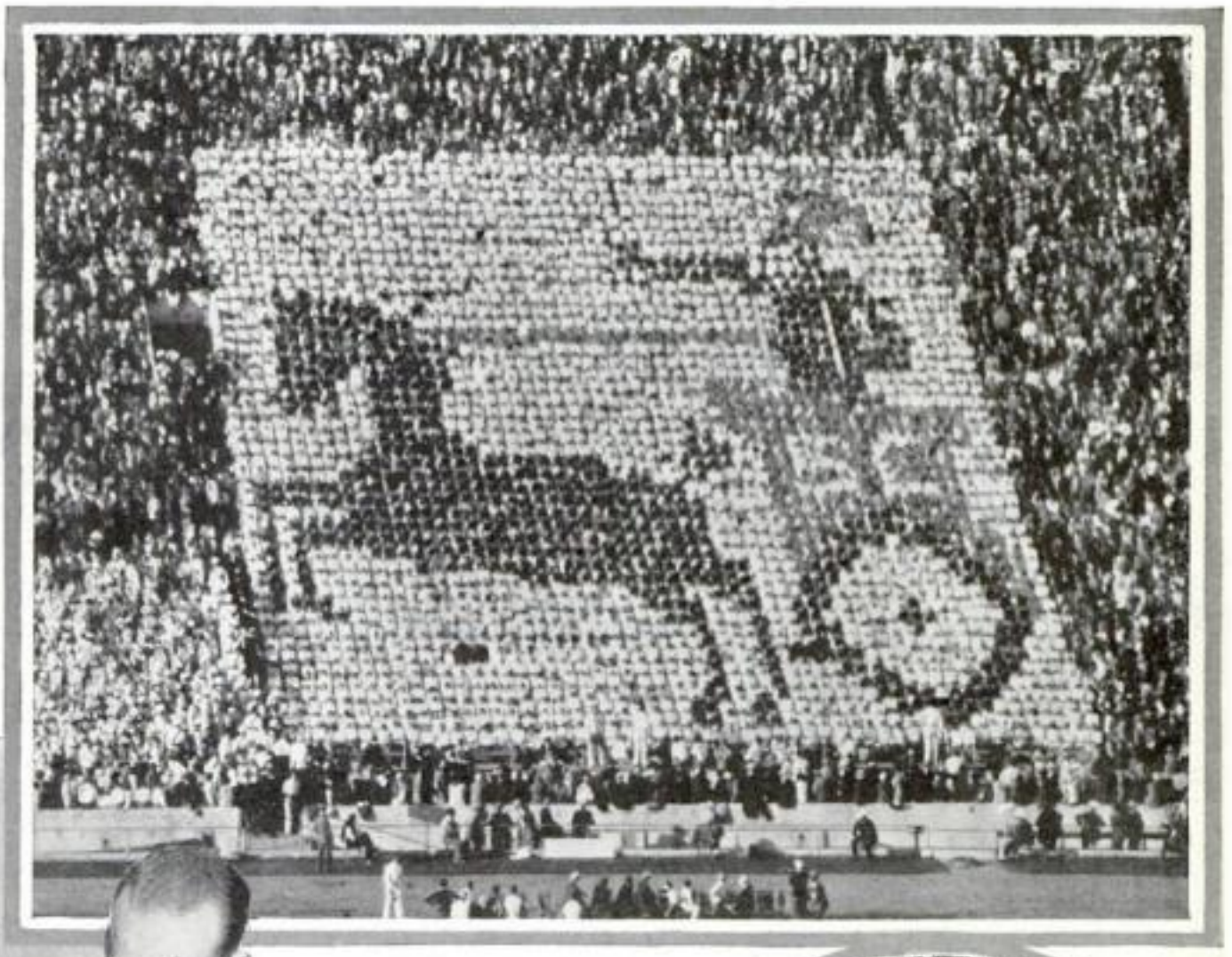
Everyone knows the durable qualities of porcelain enamel as used in bathtubs and washstands. But could it be applied successfully to external walls? Roadside refreshment stands, covered with porcelain, were the first to demonstrate that it could. Following their success, a Cleveland firm sponsored an adaptation of the idea to home building.

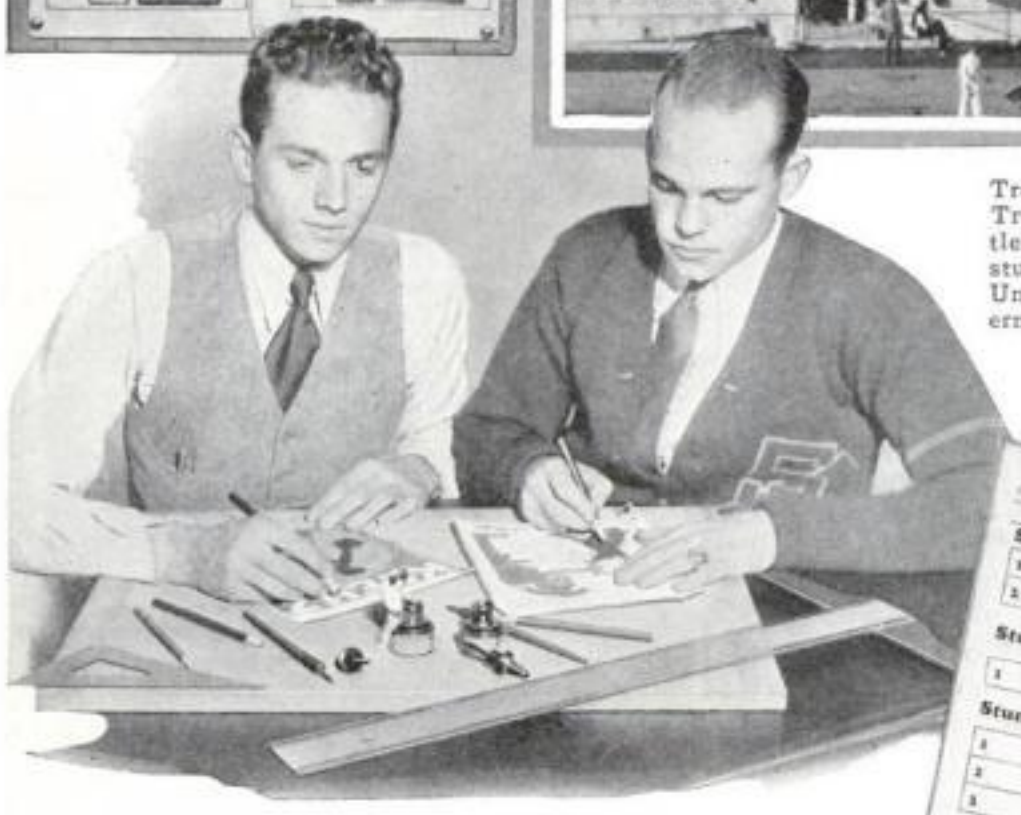
Welded steel framework supports the house. Mineral wool and fiber board insulate its walls against heat and cold. The roof shingles are of three shades of russet or rust color. A band of silvery-green trim runs along the side walls. None of the porcelain has the familiar glossy appearance; its finish is dull or "matte." Paint is employed nowhere on the exterior—giving the owner a welcome relief from painting bills. Dirt and grime are easily removed by ordinary washing. An inside covering of porcelain is provided for the kitchen, bathroom, and recreation room.

The result is an entirely fireproof home that may be built on a mass production basis. Since most of the material may be made in advance, erection requires little time. Raising the steel frame for the two-story house in Cleveland, and for a garage, took only three weeks.

Football Rooters *in Living Pictures*

Spectacular Stunts at College Games Are All Carefully Worked Out with Crayon and Paper





Trojan horse drawing Trojan warrior to battle was a spectacular stunt produced by University of Southern California rooters

Above, sketching designs, which are then transferred to cross-ruled paper as shown upper left. Each square corresponds to grandstand seat. Instruction sheet, right, is checked in colors

Above, rooters with cards picture the Trojan warrior seizing the cougar in sign of victory. Lower left, locomotive formed by rooters

HOW do rooters in the grandstand, at a college football game, form living pictures, names, and designs in spectacular between-the-halves stunts? At the University of Southern California, Trojan rooters have brought this picturesque art to a high state of perfection, and pictures on this page show how it is done.

The rooter himself never sees the complete picture at a game, and plays his mechanical part blindly. He simply raises before his face a ten and one-half by twelve and one-half-inch colored card at the command of the cheer-leader, supplemented by directions marked on sheet before him. The card has different colors, such as red and yellow, on its front and back.

Actually the stunt has been meticulously worked out in advance. As the first step the head cheerleader, and his assistants make a sketch of the picture—perhaps a Trojan horse—or a warrior brandishing a club. The picture is then transferred to a piece of graph paper, which is ruled with squares, producing a design resembling cross-stitching. Each little square on the paper represents a grandstand seat with its rooter. When the design is filled in with colored crayons, it shows at a glance the color of the card each rooter must hold to form the picture. Just before the game, therefore, instruction sheets are tacked in front of each grandstand seat and checked with colored crayons. Each part of each stunt has a letter, number, and colored check. If the cheerleader calls for stunt "A-2" and the rooter sees a red check opposite it on his instructions, he holds up his red card.

Not only single designs but "motion pictures," may be formed in this way.

Will TINY MOTORS fill Air with *Flivver Planes?*

At top, glider powered with 24 horsepower motor. Above, tiny plane pilot can push around

By
CAPTAIN FRANK T. COURTNEY

Veteran Pilot Tells How Wings Could Fly with a

A SIXTY-FOOT plane with a three-horsepower motor could be built and flown for sport. Recent advances in engine construction and lessons learned from soaring ships have made possible this remarkable feat.

A few days ago, I had lunch with several designers and the conversation turned to the possibility of flying with midget motors especially designed to power featherweight soaring planes. Afterwards, I dug up some tables and a slide-rule at home and made a few calculations. A single-cylinder gasoline engine, no larger than a quart milk bottle, I found, could furnish sufficient power to fly a ship with a span of sixty feet! Such a machine would open up a new, fascinating field of sport flying.

It is an old saying among designers that: "You can fly a barn door if you have power enough." Since 1903, the story of aviation has been largely a record of increasing horsepower.

The original Wright biplane, you remember, struggled into the air with a crude sixteen-horsepower engine. Bleriot crossed the English Channel with a twenty-one horsepower Anzani. In contrast, take two recent record-breakers. Last year's Schneider Cup seaplane, with a wing-span of thirty feet, carried a 2,600-horsepower engine and the fifty-three-ton DO-X crossed the Atlantic driven by a battery of engines that totaled 8,000 horsepower.

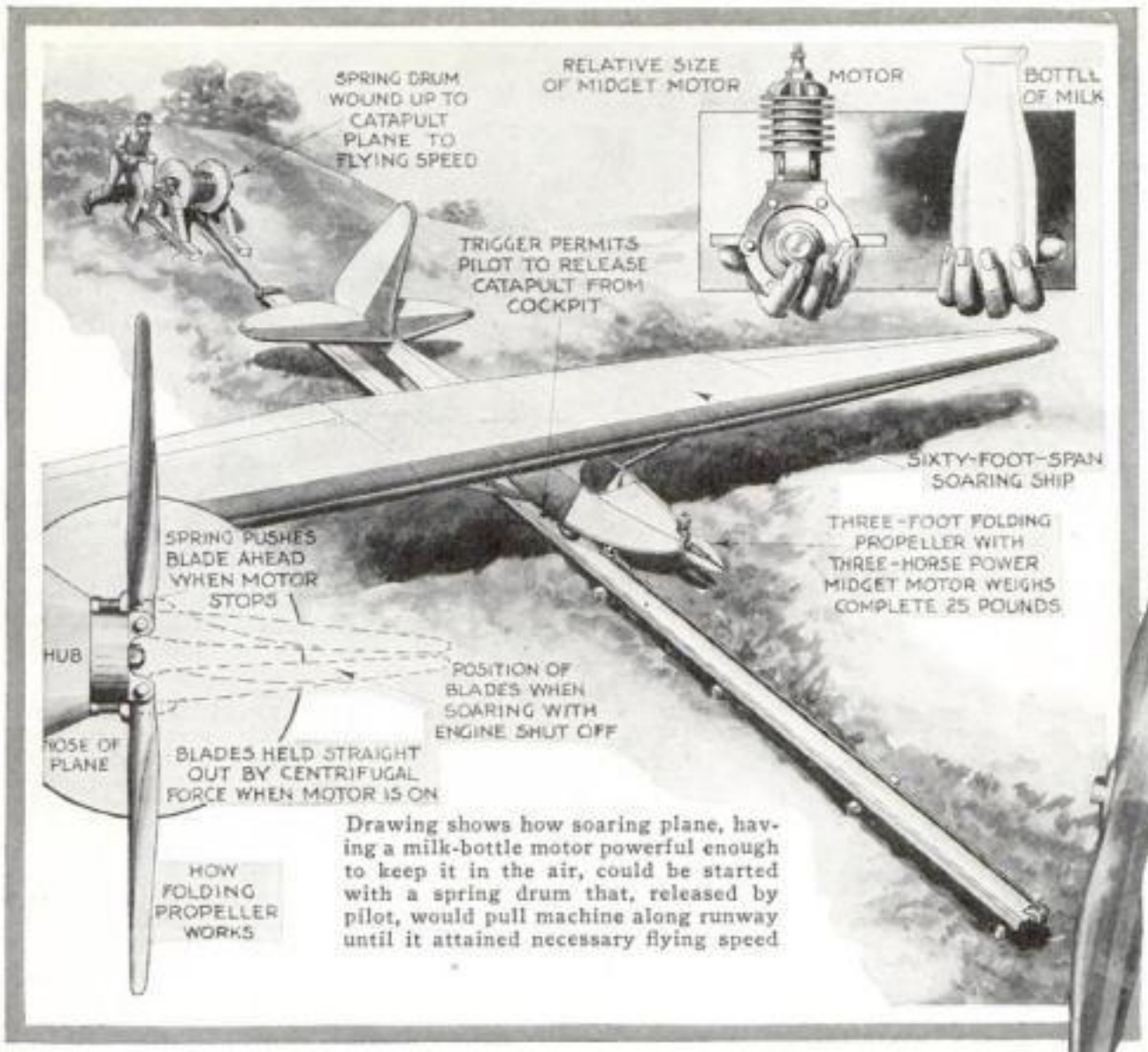
The main work of aerial designers during the last twenty years has been producing bigger, higher-powered planes. Comparatively little research has been carried on to find an answer to the question: "What is the smallest engine that will fly a plane?"

Not long ago, an inventor came to my New York office with plans for a "pedal-plane," designed to eliminate the engine. Through an arrangement of pedals and gears, he expected to keep the propeller spinning, and the craft aloft, by man-power alone. Hundreds of other experimenters, including the famous pioneers Otto Lilienthal and John J. Montgomery, tried the same thing without success. The reason man-power planes are always a failure is that man-power isn't powerful enough.

The average laborer, tests in one American laboratory recently showed, produces no more than from one-tenth to one-eighth of a horsepower throughout his working day. One horsepower is the force required to lift 33,000 pounds one foot in one minute. In actual practice, it would take the strength of four and a half horses to produce one horsepower.

Several years ago, I made a simple test to find the maximum horsepower I could develop during a short period. While a friend timed me with a stopwatch, I took a running start and sprinted up a flight of stairs at top speed. By learning the time it took me to lift my weight the height of the stairs, I could calculate how many pounds, at that rate, I would have lifted in one minute, or what horsepower I was developing. The peak mark, as I remember it, was a little over one horsepower. And the longest I could hold that was for ten seconds and probably the running start helped.

Such feeble bursts of power, further reduced by the friction of gears and the inefficiency of propellers, make sustained flight by man-power out of the question. Birds, that propel themselves through the sky, have tremendous muscles in proportion to their weight. The "white meat" along a chicken's breastbone represents the heavy muscles that flap the wings. Besides, an immense amount of energy is consumed by birds in flying. For instance, it has been



Drawing shows how soaring plane, having a milk-bottle motor powerful enough to keep it in the air, could be started with a spring drum that, released by pilot, would pull machine along runway until it attained necessary flying speed

Motors, like the one shown below, weighing twenty-five pounds, have been used in soaring planes and it is now planned to try engines that weigh only ten pounds

Glider with Sixty-Foot Tiny Ten-Pound Engine

estimated that an active crow is capable of eating a dozen times its own weight in a single day.

In spite of these facts, man-power planes continue to be proposed. During the eighteen years I have been engaged in flying, test piloting, and engineering work, I have seen scores. The commonest kind is the "winged bicycle." The idea is to pedal at top speed across a field until the wings lift you into the air.

In 1922, at the Itford Hills soaring and gliding meet, in England, I watched one of these "flying bikes" make a dozen attempts to take off. Every time, just before sufficient speed was attained, the wings would begin to lift the weight off the wheels. They would spin around, unable to "grip" the ground, and no matter how hard the operator pedaled, he could not give his apparatus the last-minute drive necessary to get off.

When Darius Green, in the famous Trowbridge poem, jumped off the barn roof with his home-made wings and landed with a thump, he shook his head and muttered. "The birds can fly so why can't I?" The answer is: "Because you aren't strong enough. You need a motor." But, how small can this motor be?

In heavier-than-air flight, most of the power is required on the takeoff and in climbing. A twelve-passenger Bellanca airplane, for example, can maintain level flight on about 145 horsepower. But the Cyclone engine it carries develops more than three and a half times that power, the excess aiding in a quick takeoff, fast climb, and high speed.

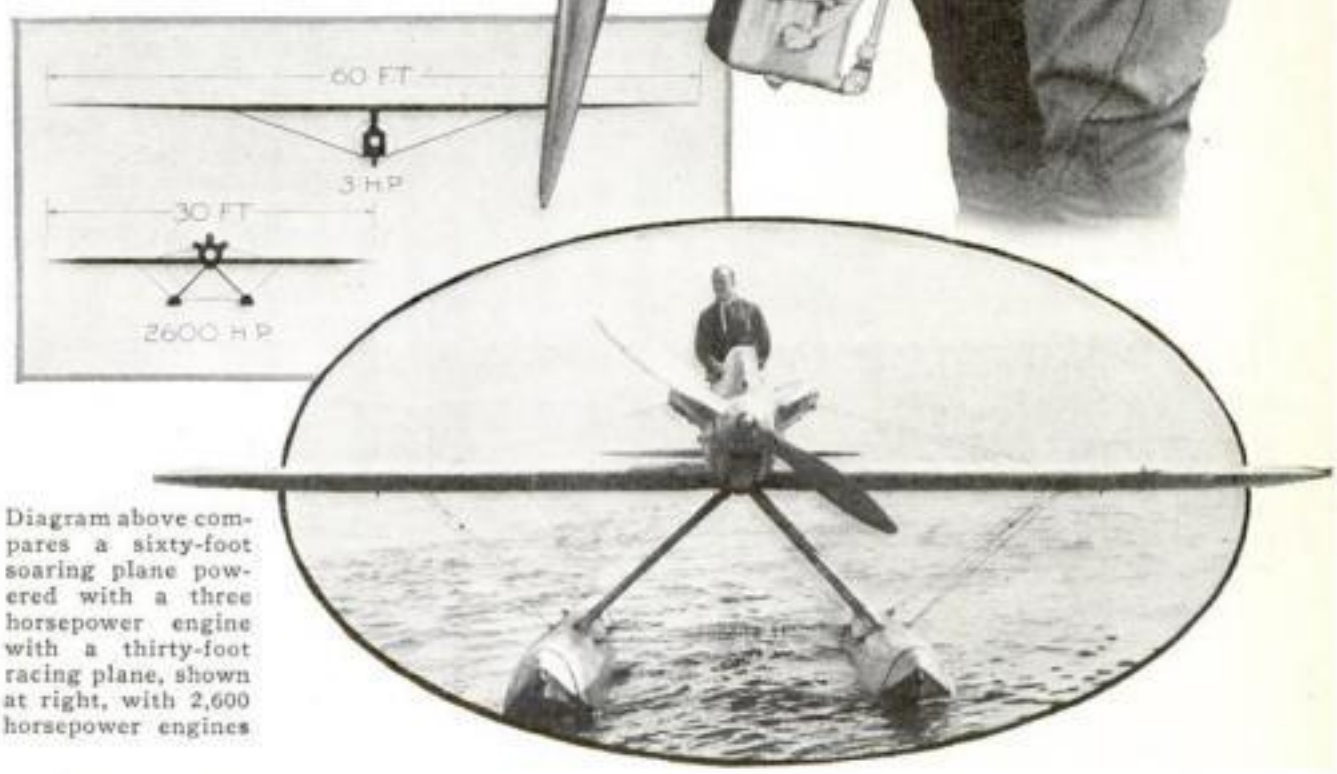


Diagram above compares a sixty-foot soaring plane powered with a three horsepower engine with a thirty-foot racing plane, shown at right, with 2,600 horsepower engines

The type of machine that requires the least power to stay in the air is a streamlined, wide-winged soaring ship. A craft like the American-built "Haller-Hawk," which weighs, empty, 287 pounds, has a wing area of 167 square feet, and a span of approximately sixty feet, could be kept in level flight by a motor delivering two horsepower at the propeller. An additional horsepower would permit it to gain altitude at the rate of about eighty feet a minute.

In the past, most attempts at building light planes have employed motorcycle engines to furnish the power. I remember one little ship, named the "Wren," that got off from a long stretch of sand on the English seacoast several years ago with a seven-horsepower motorcycle motor. That is the lowest-powered plane ever to fly, so far as I know.

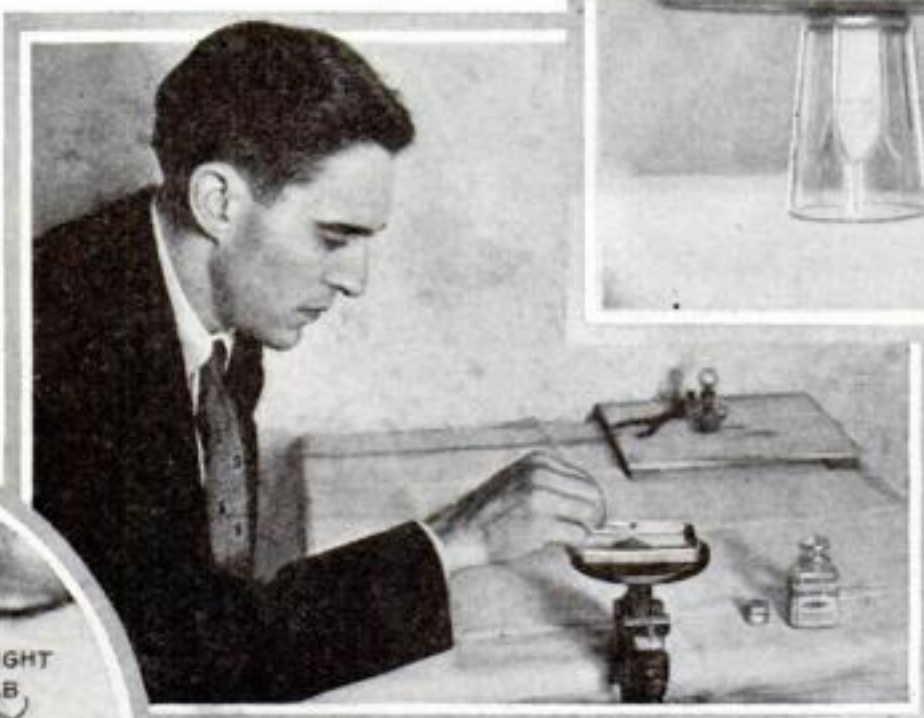
According to the U. S. Department of Commerce, any machine that has less than one-fifth horsepower per square foot of supporting surface, is in the light-plane class. The midget-motored machine, suggested in this article, would have less than one fifty-fifth of a horsepower per square foot and, of course, would require a special category with the Department of Commerce.

Motorcycle engines are always comparatively heavy. What is needed, and what has never yet been supplied, is a tiny, super-light motor, especially designed for the work. Every ounce that can be cut from the weight of the power-plant lessens the load the motor has to drag "uphill" in climbing and reduces the size of the engine required.

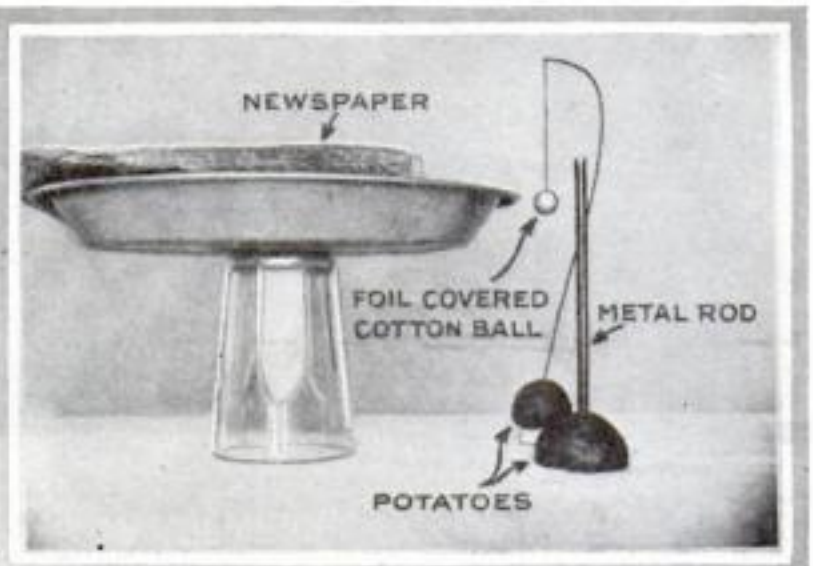
For a number of years, an experimenter in Chicago, Elmer A. Wall, has been turning out unusual miniature gas engines for model air- *(Continued on page 110)*

Home Tests of Nature's Secrets

You Can Demonstrate for Yourself the Action of Mysterious Laws in the Realm of Science by Using the Things That Are Always at Hand

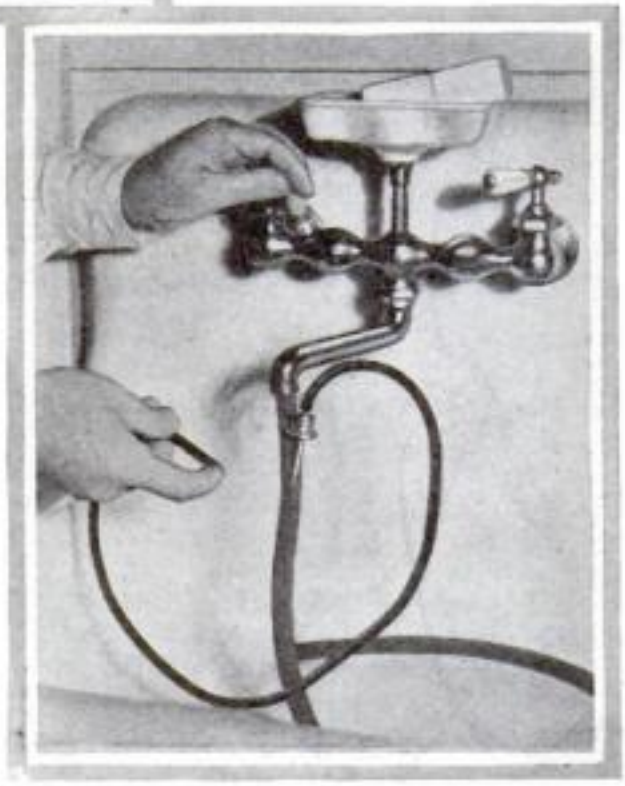


TESTING A STRANGE LAW. This experiment, which demonstrates a useful law of electricity, can be performed easily with two coils of bell wire, a small flashlight, and a 100-watt bulb. Connect one coil of wire in series with the bulb and connect the flashlight directly to the other coil. Turn on the current so the bulb is lighted and then bring the two coils of wire close together. As you do so, the flashlight will light. This action is the result of induction, a principle used in constructing transformers



ELECTRIFIED NEWSPAPER. That a newspaper contains static electricity can be proved with the apparatus shown above. Suspend a ball of cotton covered with tin foil on a wire as shown. Rub a newspaper and drop it on the tin. The ball will swing between pie tin and metal rod

HOW TO GET GREAT HEAT. Scrape a teaspoonful of iron rust off an old pipe and mix it with the aluminum powder found in the bottom of a bottle of aluminum paint, being sure that a little of the paint solvent remains in the powder. If this mixture is ignited, there will be a puff, a blinding flash—and a hole burned deeply into whatever substance the mixture was resting upon. In this miniature thermite welding system, enormous heat has been generated



SIMPLE AIR PUMP. With the vacuum pump, right, which can be put together for twenty-five cents, many interesting home experiments can be performed. The pump is made of ten cents worth of windshield wiper hose, ten cents worth of larger hose, and the spout from a five cent oil can. When connections are made suction is created at the end of small hose

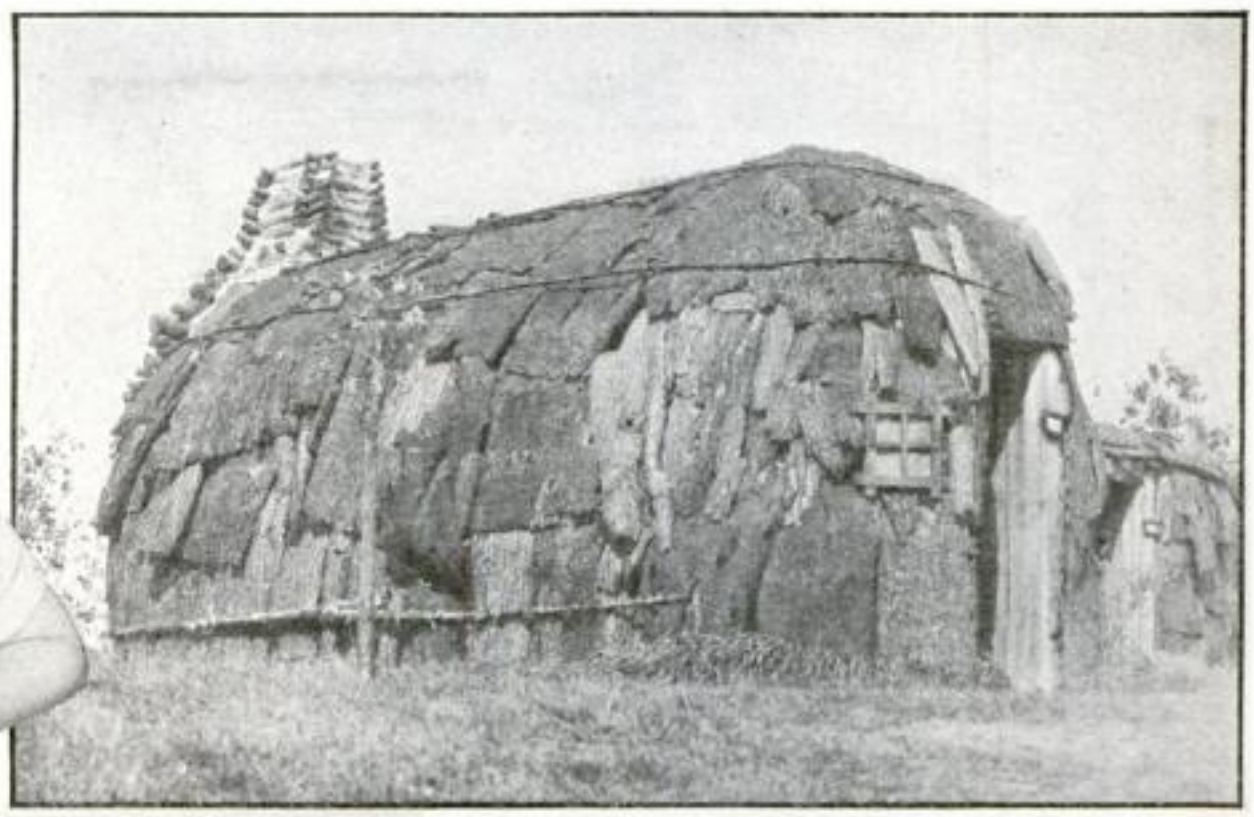
WANDERING MUSIC. Take two glasses as shown at left, and across the top of one draw tightly a thin rubber band, fastening it in place with cement and string. Plucking the rubber band will start the glass vibrating. Now if the second glass is brought close to the first, it also will vibrate because it is in resonance with the first glass. If with your hand you stop the first glass, the second will continue to vibrate

BEATER WARMS WATER. A mysterious little experiment is possible with an electrically driven stirring machine, a bowl of water, and a thermometer. If you place the thermometer in the water while it is being violently agitated by the machine, you will find that the water's temperature rises slightly. This is called the "mechanical equivalent of heat," and it is believed that the heat is generated in the water by the friction of the molecules of water gliding over each other at high speed

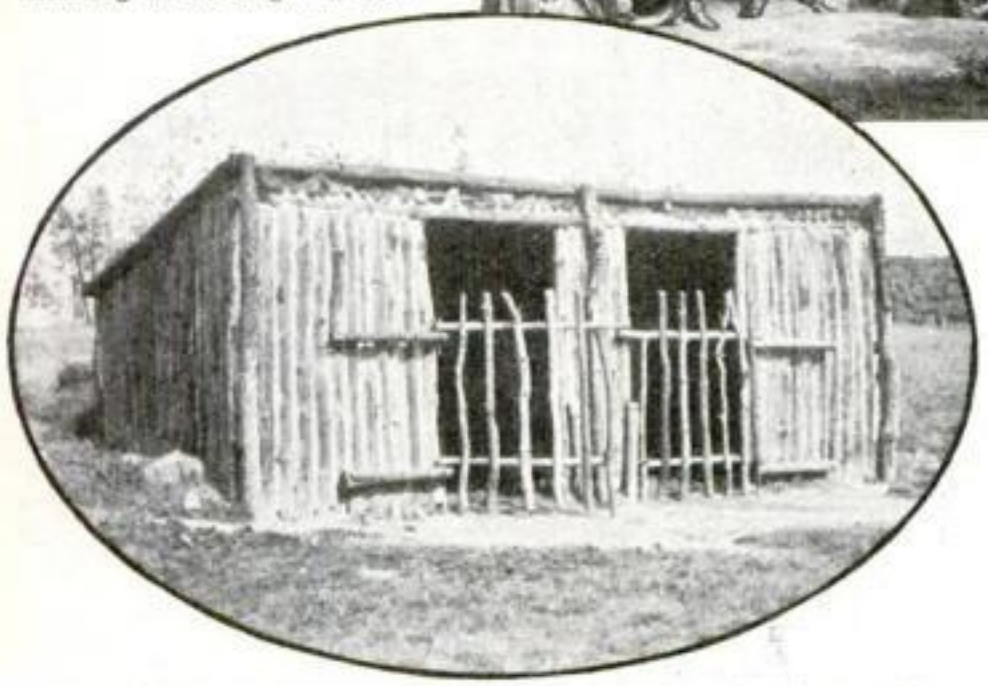
COLD MAKES WATER BOIL. Here's an experiment with which you can baffle your friends. Boil water in a bottle and then cap it tightly. In a few minutes, steam will cloud the neck of the bottle and the water will stop boiling. Now hold bottle under the cold water faucet, so water strikes portion of bottle containing the steam. The water will again begin to boil, as the cold condenses the steam, creates a vacuum, and reduces pressure so residual heat boils water

Pilgrim Fathers' Homes Seen in Exhibit

In the early days of Colonial history, nails like these were used in New England as money. At right, reproduction of a famous painting depicting the Landing of the Pilgrims, 1620

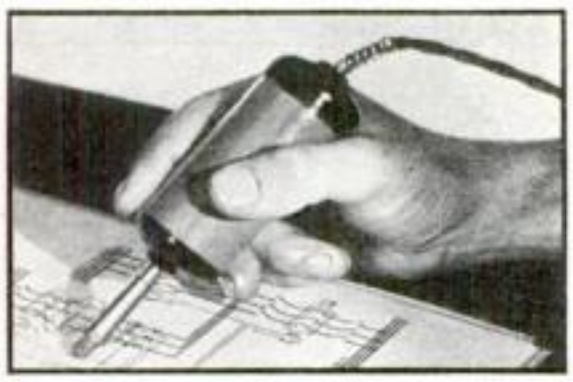


Above, very early bark house with wood chimney. Below, man powered sawing pit where logs were cut



One of the log barns in which the Pilgrim Fathers sheltered their cattle, rebuilt for exposition of Colonial history at Salem, Mass.

TO SHOW Americans how the Pilgrim Fathers lived, a unique exhibit has been erected at Salem, Mass. It consists of a group of structures exactly duplicating the dwellings of the first colonists upon the same spot. Successive models show the evolution from the rude, bark-covered houses of 1620 to the more substantial lumber dwellings that followed the operation of sawmills. After inspecting such an exhibit, those who live in the comparative ease of the twentieth century have a better idea of the stern, simple surroundings in which the pioneers celebrated their first Thanksgiving. In their successful struggle to gain a foothold in what was then a wilderness, they were forced to make the best of materials at hand. Bricks were unknown, so chimneys were made of wood. Nails were at a premium, and as late as 1680 they were used in Rhode Island in lieu of money.

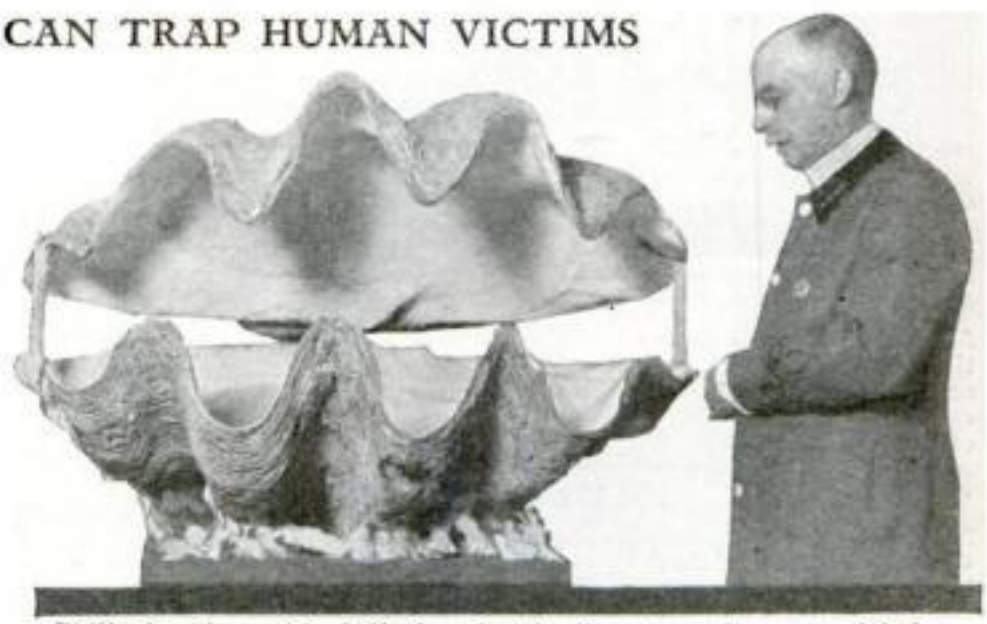


ELECTRIC ERASER DOES THE RUBBING FOR YOU

AN ERASER that does the rubbing for you, in removing pen and pencil marks, is now on the market. The machine receives electric current through a six-foot cord that can be plugged into any convenience outlet.

GIANT CLAM CAN TRAP HUMAN VICTIMS

A GIANT clam, found in Australian and Philippine reefs can trap human victims, a recent report to the American Museum of Natural History states. When its open shells lie flush with a reef or hidden below water, an inadvertent wader may step in. Then the jaws close and only a crowbar can open them.



Philippine clam with shells four feet in diameter and so powerful that when they close on human being, a crowbar is needed to force them apart

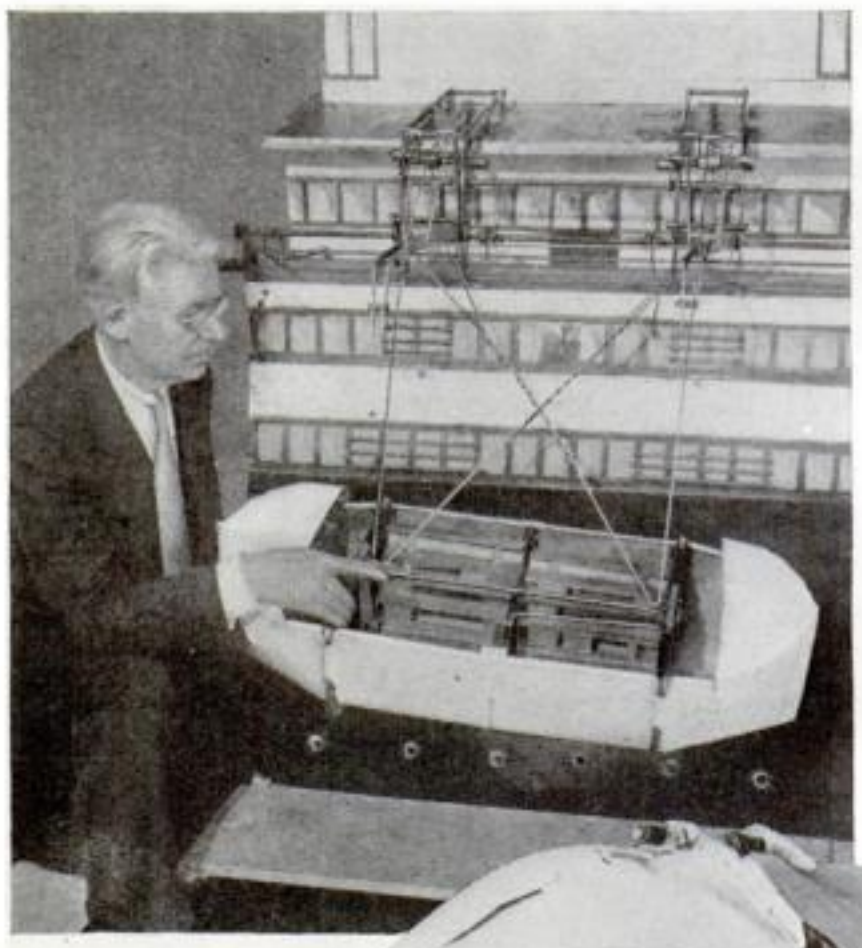
Our Tung Oil Industry Started in Cemetery

At left is a cluster of tung tree fruit which contains the highly prized seeds. Below, fruit split to show seeds from which the tung oil is obtained

At left, a tung tree in a Georgia grove. It takes its name from the large heart shaped leaves, the Chinese word for heart being tung

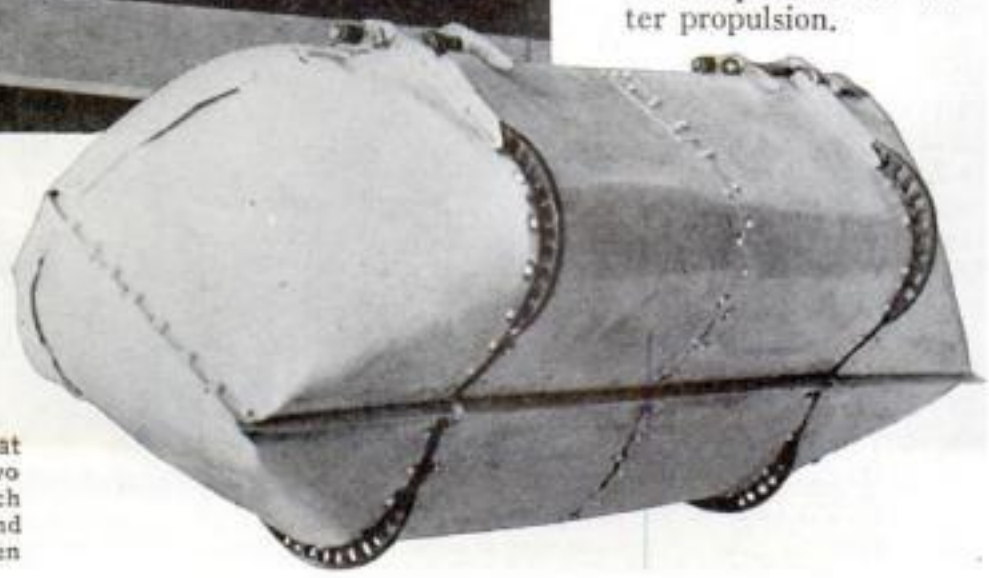
To FIVE seedling trees, neglected for years in a Florida cemetery, has just been traced the birth of an American industry valued in millions of dollars. Thirty-one thousand acres of the southern United States are now devoted to the cultivation of the tung tree, according to a recent Government survey. Seeds of this tree yield an oil that is widely used in paints and varnishes. (P. S. M., July, '31, p. 52.) China held a virtual monopoly of the tung oil industry until the discovery of the tung seedlings at Tallahassee, Fla. Raised from Chinese seed, they showed that the tree could be grown successfully in this country. The seedlings were transplanted. Four died, but the fifth flourished. It furnished the seeds from which America's first bearing grove of tung trees was grown. The tree has proved to be hardy, grows rapidly, and is profitable.

ROLLERS HELP LAUNCH NEW LIFEBOAT

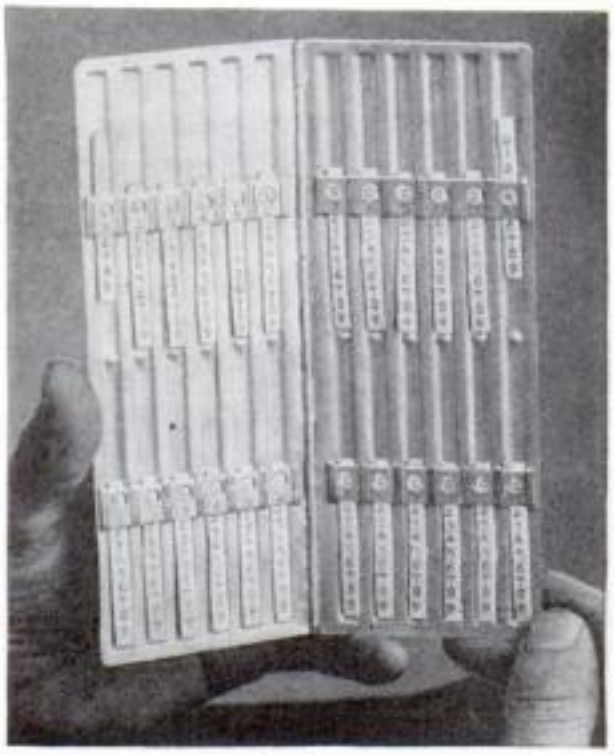


REVOLVING wheels help a new style of lifeboat down the side of a sinking ship, and propel it after it is in the water. Thus the life-saving craft may be launched on an even keel despite the listing of the doomed ship, according to the New York inventor. With the aid of a working model, he recently demonstrated the difficulty of launching an ordinary lifeboat from a listed vessel. The new type rolls down the hull on a pair of rotating rims near bow and stern. They are equipped with motor-driven paddles for water propulsion.

Above, demonstration of launching new lifeboat that can slide down hull of ship on rollers



Close-up of lifeboat that is equipped with two pairs of rollers on which it can be launched and by which it is also driven



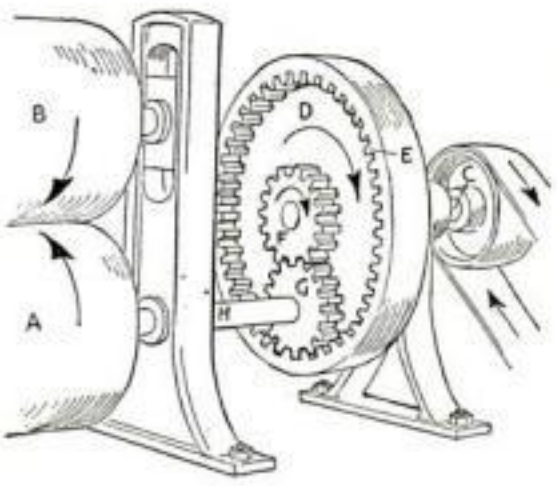
GOLF SCORE ON METAL

An all-metal scorecard for golfers, that may be used over and over again, is the product of a Hoopeston, Ill., inventor. It consists of two hinged leaves stamped out of aluminum, with twenty-four marker strips. Each strip is numbered up to nine.

FREAK LEMON IS PINK

PINK lemonade might be made without resort to artificial coloring from the fruit of an odd lemon tree, discovered in a Burbank, Calif., orchard not long ago by an expert of the U. S. Department of Agriculture. The lemons from this tree have pink flesh and juice.

Can You Invent It?



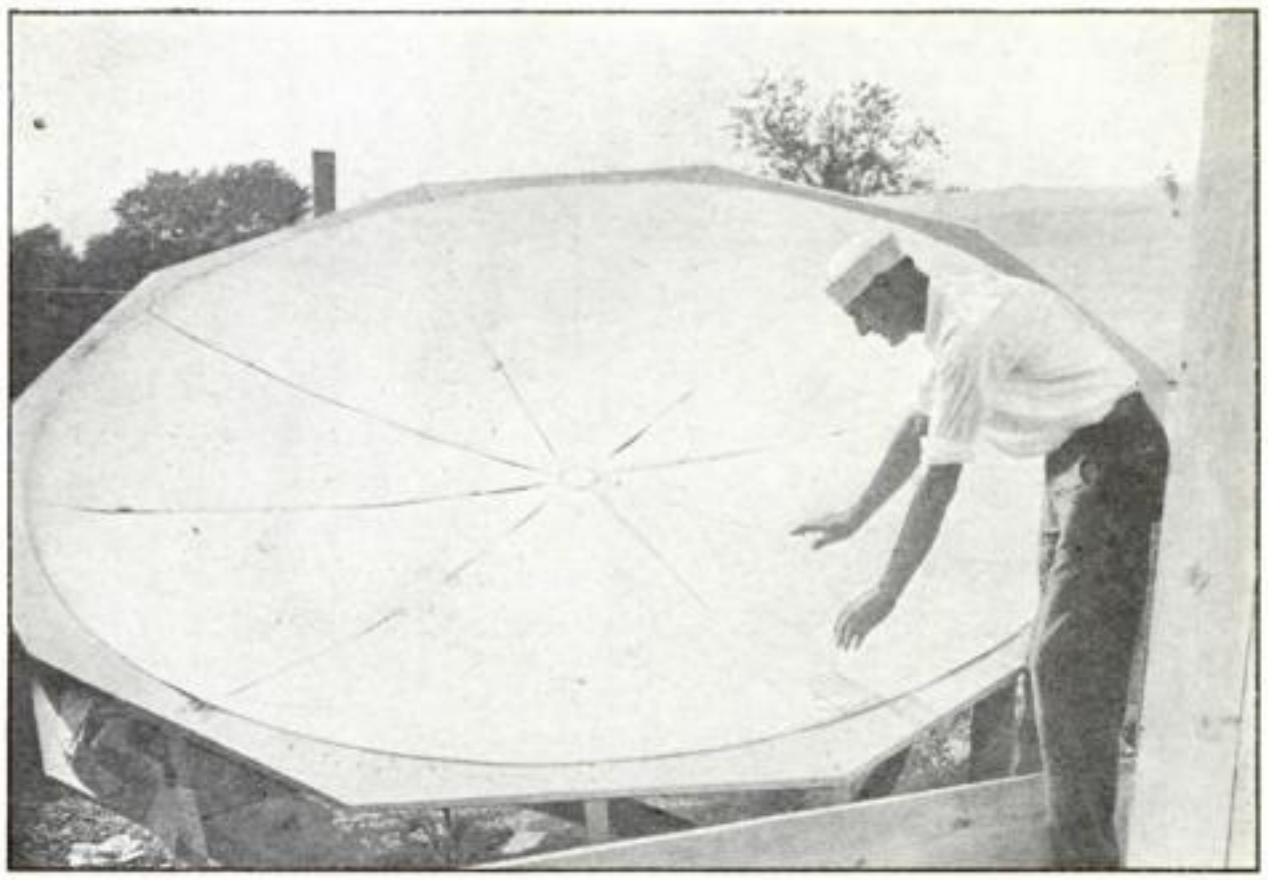
CAN you make the changes needed in this mechanism to enable the clothes-mangle to operate in the following way: It is desired to have the two rolls, *A* and *B*, turn slowly inward, in the direction of the arrows, and then reverse their directions of motion. After reversal, they must turn rapidly outward. The power is delivered to the mangle by the belt, which rotates the shaft *C*, carrying the disk *D*, upon which are immovably fixed the internal gear ring *E* and the cogwheel *F*. The cog-wheel *G*, keyed upon the shaft *H*, rotates the lower mangle-roll. The upper rolls upon the lower by contact, as it is fitted with sliding bearings at *I*.

• •

LAST month you were given the problem of using an open wound coil of round brass spring wire to produce a hollow flexible tube of the same diameter as the coil, without in any way modifying the coil. You were free to make any additions you liked to the coil. In order to do this, a coil of triangular wire must be wound tightly over it. The inner faces of the triangular wire are thus wedged into contact with the coils of the round wire. When the coil is bent, the triangular wire is crowded out on one side and let in proportionately on the other, thus keeping the continuous joint between the two coils always tight, with the parts always in close contact. The diagram shows the left end cut away to reveal the relationship between the two coils and how the hollow flexible tube will now operate.

Drawing shows how coil of spring wire is converted into flexible tube of same diameter

SUN FURNACE TO GIVE GREAT HEAT



HARNESSING the sun's rays to fuse pottery materials is the aim of Paul Morrison and George Aderhold, of Saxonburg, Pa. They are constructing a giant solar furnace that, when completed, will be 100 feet in diameter. Concentric rings of polished, chromium-plated metal will reflect the sun's rays and bring them to a focus seven feet from the furnace's center. At this point, the experimenters expect a temperature of 5,000 degrees F. to be obtained. The photograph above shows one of the sections of the solar furnace, which, it is said, will be the largest in the country.

PRISON GUARDS GET NEW WARLIKE VEST

WARLIKE in mien is a new vest designed for prison guards, allowing free use of both arms. Eight tear gas grenades and eight riot gun shells may be carried in the garment, each in an individual elastic pocket so that they are instantly accessible. Wearing the vest over his uniform or blouse, a guard becomes a walking ammunition carrier ready for quick action in the presence of any prison emergency.

New vest for prison guards holds tear gas bombs and riot gun shells

CLEAN STAINED GLASS WINDOWS WITH DISCARDED RAZOR BLADES

A NEW use for old safety razor blades was found recently when the stained glass windows of famous Trinity Church in New York City received their first cleaning in eighty-six years. In expert hands, the blades successfully removed all of the dirt. Scrubbing with washing soda completed the task.

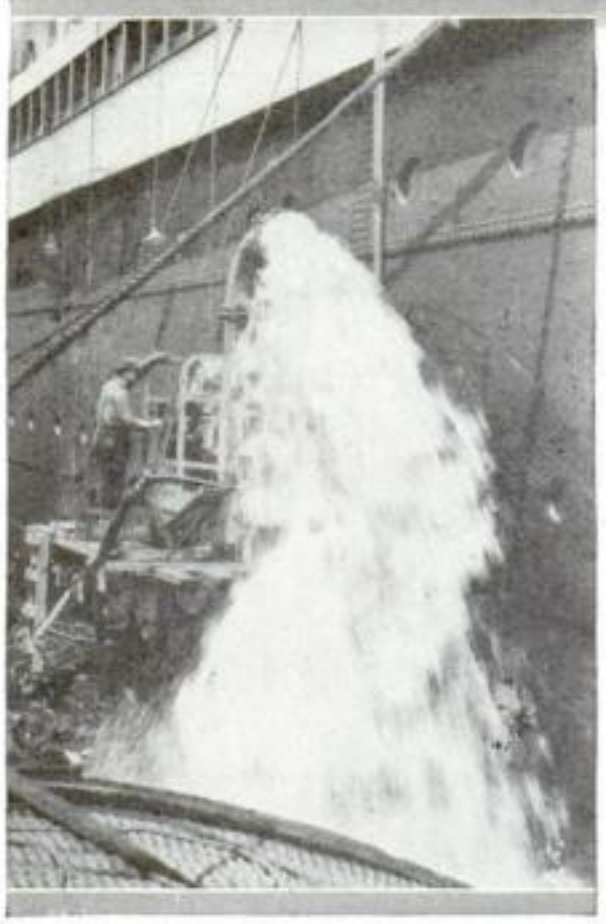
BIG PEAT BED MOVES

LIKE a glacier of black ice, ten million cubic feet of peat moved more than two miles down a valley in County Mayo, Ireland, a few months ago, in one of the few known bog flows of history. The semi-liquid mass, advancing like a wall, carried along stones and boulders.

Bow of *Bessengen*, right, sunk in New York harbor, was cut off with underwater torches, raised, and towed to scrap heap. Below, salvage diver, with oxy-electric cutting torch, ready to cut away chain fouling a ship's propeller

Fighting the Sea for WRECKED

By
Robert E. Martin



Twelve-inch gasoline pump drawing water from a patched hull, so sunken boat can be raised and towed away

BRINGING dead ships to life, saving the sinking and disabled, rescuing cargoes, raising treasure from the deep! These are the romantic and hazardous everyday duties of the little known race of men and the odd fleet that carry on the strange business of the Black Horse of the Sea.

Flying a rectangle of white bearing the device of a riderless black horse wildly running, a powerful tug races halfway across the Atlantic to the assistance of a freighter disabled by engine trouble. Two others, towing colossal floating derricks, hasten toward Buzzards Bay to refloat a trim yacht stranded on the rocks.

Under the same queer emblem, a band of divers grope in the silt at the bottom of New York harbor, patching holes in the steel shell of a $1,000,000 Government dredge preparatory to pumping it out, raising it, and putting it again in service. Off the lonely coast of Lower California, with armed guards patrolling the deck of their ship day and night, Black Horse divers and salvage experts wrest from the ocean a fortune in sunken gold.

Nearly three quarters of a century ago the Black Horse flag was first broken out by Captain I. J. Merritt from the mainmast of the *Henry W. Johnson*, a Gloucester mackerel fisherman turned salvage vessel. A symbol of the fast horses that bore the messengers of the old coast patrol, this device—by the daring exploits of its ship and crew—marked the beginning of a new swift succor on the deep.

Today, as house flag of Merritt-Chapman & Scott, largest marine salvage concern in this hemisphere, its vessels ply from Maine to the Caribbean, from Alaska to the South Seas. To cope with the vast and rapid growth of modern shipping, it has developed almost a separate science with a technique of its own. With millions of dollars worth of specialized equipment, a hundred ships—super-powered tugs, lighters, barges, floating derricks capable of lifting from fifty to 350 tons—and crews of several thousand veterans at its precarious work, the Black Horse now tackles the myriad perilous problems of the twentieth century sea.

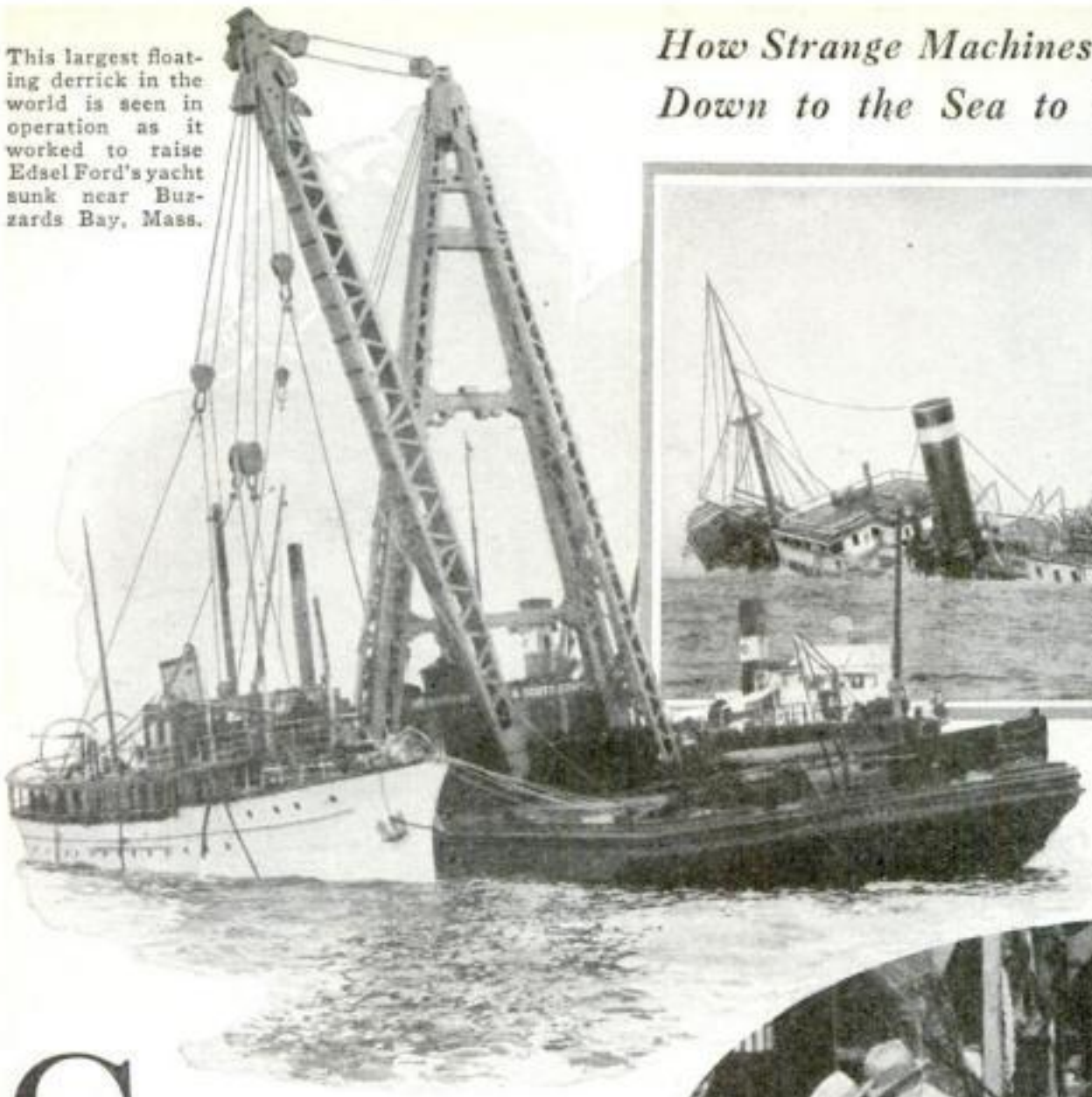
Versatility, resourcefulness, determination, and no small measure of courage are the stock requirements of the men who man the salvage ships; for all salvage jobs are trying, many hazardous, and no two exactly alike.

The salvage officer, director of operations, must be engineer, seaman, executive, and master of a dozen trades. The divers, his underwater hands and eyes, must be also marine surveyors, masons, mechanics, carpenters, experts with the oxy-electric torch. His crew must be able to turn to anything from sailing the vessel, constructing wooden braces and patches, sewing canvas bags, mixing concrete, handling pumps and winches, manipulating steel hawsers as big around as a man's neck, to saving lives and fighting pirates!

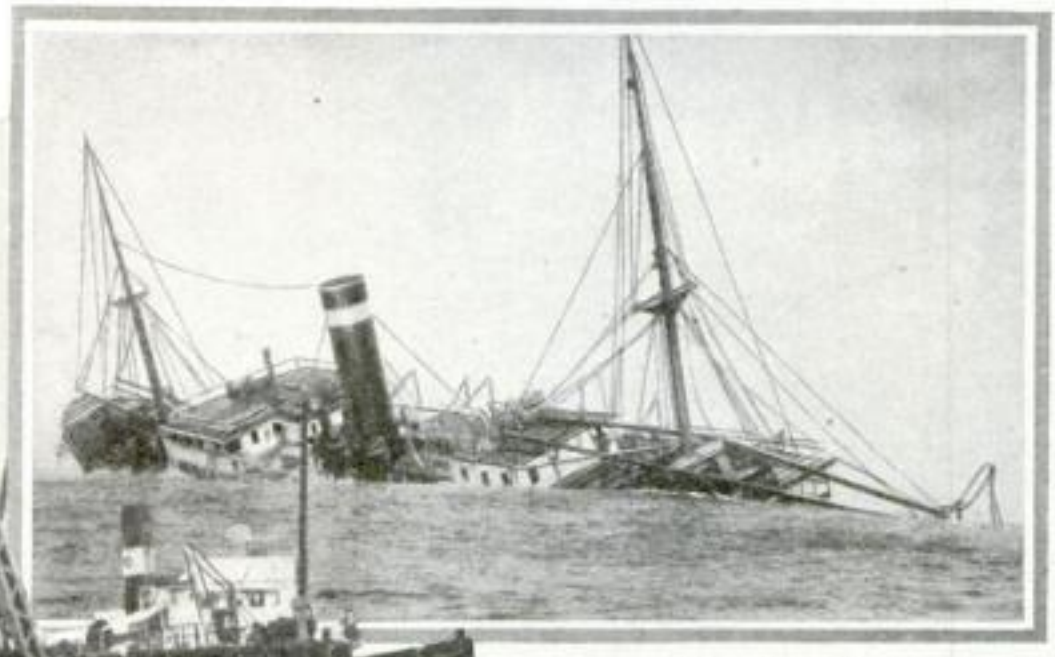
Wet, chilled to the bone, salvors work day and night to float a freighter stranded on rocks. Divers apply patches of wood and concrete; slings are strung under the hull to the booms of great derricks; millions of gallons of water are thrown from the holds by gasoline pumps. Slowly the ship rises. She floats almost enough to be towed away. Then a gale breaks unexpectedly. Water must be let in; to steady her the ship must again be sunk! The work must begin all over some other day. Such is the perverse character of salvage.

In the days of wooden ships, terrible

How Strange Machines Help the Men Who Go Down to the Sea to Salvage Lost Treasure



This largest floating derrick in the world is seen in operation as it worked to raise Edsel Ford's yacht sunk near Buzzards Bay, Mass.



Above, the *Colombia*, stranded on reef off Point Tosca, Mexico. The large gold shipment it carried was all recovered. Below, checking up the gold and silver treasure that was taken from the wrecked *Colombia*

SHIPS

risks were necessary to take the crew off a stranded vessel, or for the salvage crew to get away, with bad weather and the ship in imminent danger of breaking up. But with the strong steel ships of today, the ship is often safer than the best of lifeboats.

Captain W. N. Davis, veteran salvage master, remembers the case of the British steamer *Ariosto* as a striking example of this truth. Stranded on the coast of North Carolina, near Hatteras Inlet, the *Ariosto* began to leak badly. Believing that his ship was on the dreaded Hatteras Shoals, the captain gave the order to launch the lifeboats. Two boats were lowered and all but the captain, chief engineer, and third officer got into them.

Just then a Coast Guard patrol discovered the ship and burned a red flare to show that she had been sighted. Realizing that help was near, the captain advised his men to come back on board, and a few did so. But the sight of the red flare was too much for the others, and with a cheer the boats started for the beach. Out of the shelter of the ship, both capsized. Of thirty-one men, not a man survived.

The *Ariosto* stranded on Christmas Eve; and from the following day until the end of March the salvage crew lived on board the ship in perfect safety. Her cargo of cotton was saved, her hull patched and pumped, and, except for bad luck with weather, the vessel herself would have been saved.

When a ship grounds on a sandy beach, and the hull is not broken, refloating is generally an easy matter. Having fastened steel hawsers, fifteen inches in circumference, to the stranded vessel, the salvage ships anchor a safe distance seaward. Then, when the tide is full, powerful steam winches commence a slow but mighty tug-of-war. Inch by inch, shuddering under the strain, helped on by the deepening water, the stranded vessel is hauled to sea.

Often the Black Horse is called upon to remove a sunken ship that is too much battered to be reclaimed, but which, if left on the bottom, would be a danger to navigation. In New York harbor, where traffic is congested and collisions comparatively frequent, salvagers may be working on two or three such wrecks at the same time. Cut apart by dynamite and the underwater torch, the sections are either left on the bottom in deep water or lifted by derricks. One of these giant devices, the *Monarch*, is the most powerful floating derrick of its type in the world. Fitted with automatic ballasting apparatus, to compensate for the load, it can lift 350 tons overside.

Perhaps the most difficult job of marine salvage is the raising intact of a great liner from the bottom of the harbor waters—ready, after reconditioning in a dry dock, to sail again. The raising of the *Muenchen*, sunk two years ago at her New York pier, is the most recent notable example. But the somewhat similar raising of the *St. Paul*, in 1918, had the added distinction of being the first great salvage venture in which was used the underwater cutting torch.

While being maneuvered at her pier in the Hudson River, the *St. Paul* mysteriously heeled over, sank, and settled in a dozen feet of mud. Two thousand tons of liquid mud poured through the breaks and open portholes.

More than fifty feet below the surface, unable to see a foot before their faces, divers groped through the muck, closed more than 500 openings in the hull.

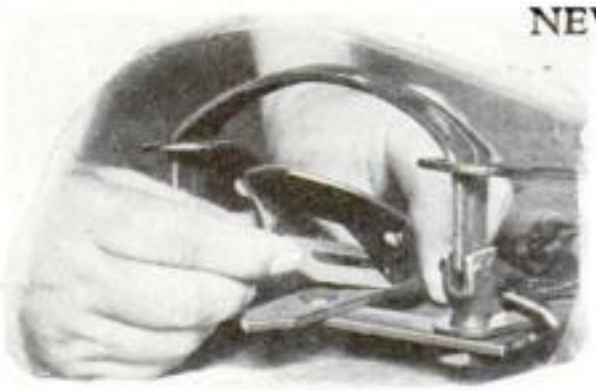
Though bulkheads are useful to a ship afloat, they were definite obstacles to the salvagers of the sunken *St. Paul*. To maintain the balance and facilitate the pumping out of the ship, these engineers wanted a free flow of water from stem to stern. So they decided to *(Continued on page 107)*

Ruins of Turkish Bath, Built by Romans, Found in England

Banquet hall in Roman ruin, unearthed at St. Albans, England, had a remarkable mosaic floor. Picture shows workers cleaning away the dirt of centuries and exposing the floor's design

TURKISH baths were popular among ancient Romans as early as 200 A.D., new discoveries show. Recent excavations at St. Albans, England, revealed the ruins of a palatial Roman establishment for steam bathing. An adjoining banqueting room indicated that a visit to the baths might have been attended with ceremony and festivity in those days. Expert craftsmen were evidently among the Romans who inhabited England, for among the finds was an exquisite mosaic floor rivaling the best of the period. According to archæologists, the spot marks the site of the early Roman capital of south Britain.

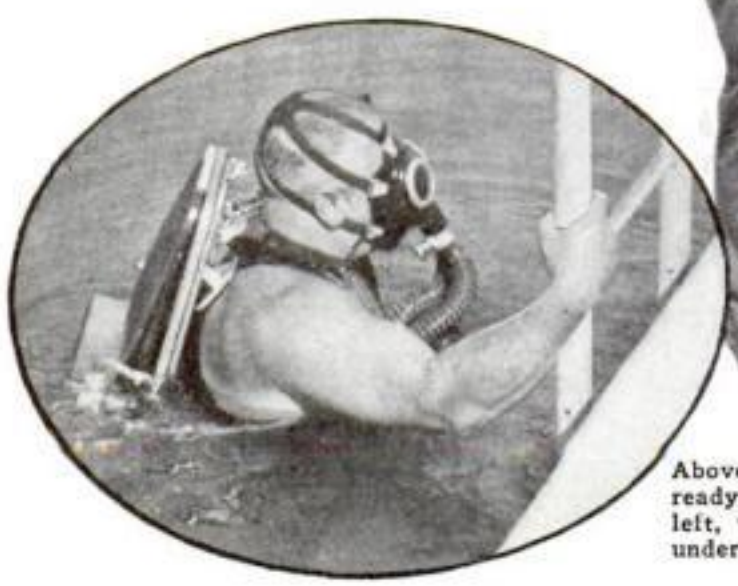
NEW TRAP CAN'T CATCH BIRDS



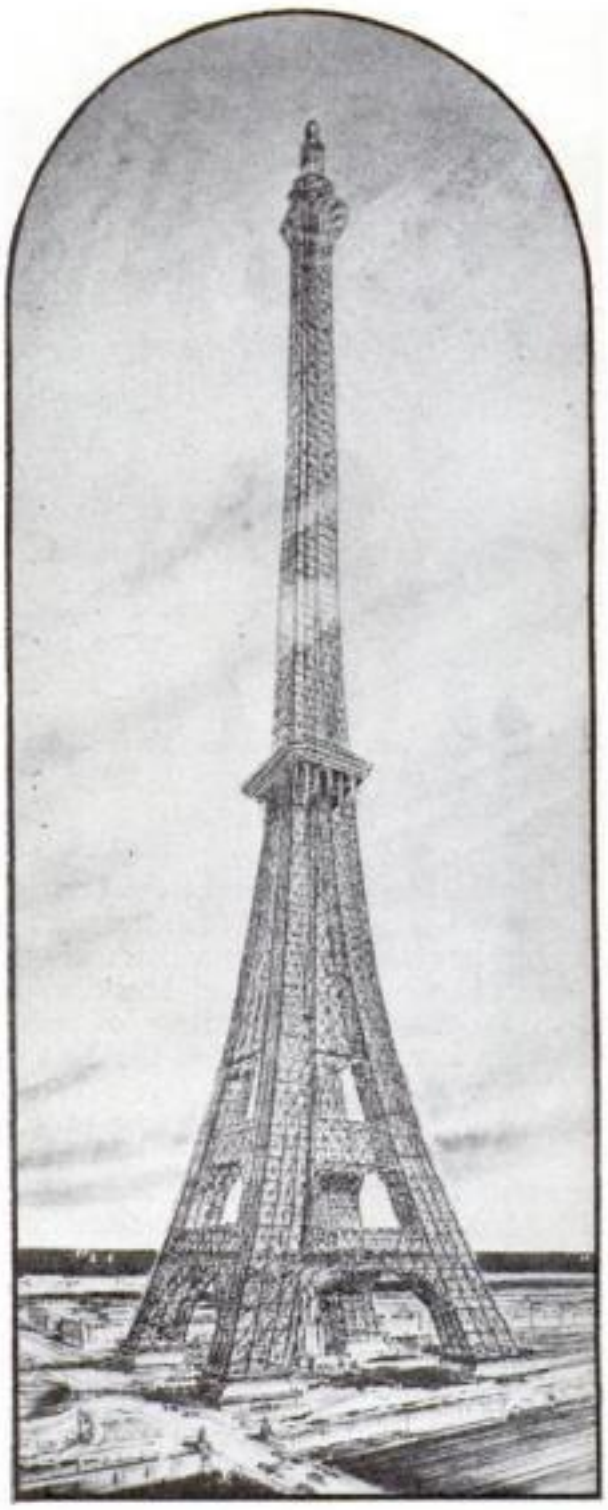
TO PROTECT birds and small animals from big-game traps, a safety attachment for standard steel traps has been devised by Albert M. Day, biologist of the U. S. Department of Agriculture. This invention, a thin detachable spring of steel, is slipped under the pan post of the trap as shown in the photograph at the left. After this has been done, the weight of a small animal will fail to spring the trap.

RESCUE MASK PROTECTS FROM GAS AND WATER

RESEMBLING the portable "lung" carried by a submarine crew to escape from a hatch beneath the water, a new type of rescue mask was tested recently by the emergency squad of New York City's police. Wearing this device, one can brave smoke, water, and poisonous gas with impunity. In one of the tests pictured here, a patrolman was successfully lowered to the bottom of a pool at Rockaway, N. Y., with only the new mask to supply him with oxygen during the time he was beneath the surface of the pool.



Above, wearing an oxygen tank, policeman is ready to don rescue mask like the one worn at left, which saved officer from drowning while under the water. Mask also protects from gas



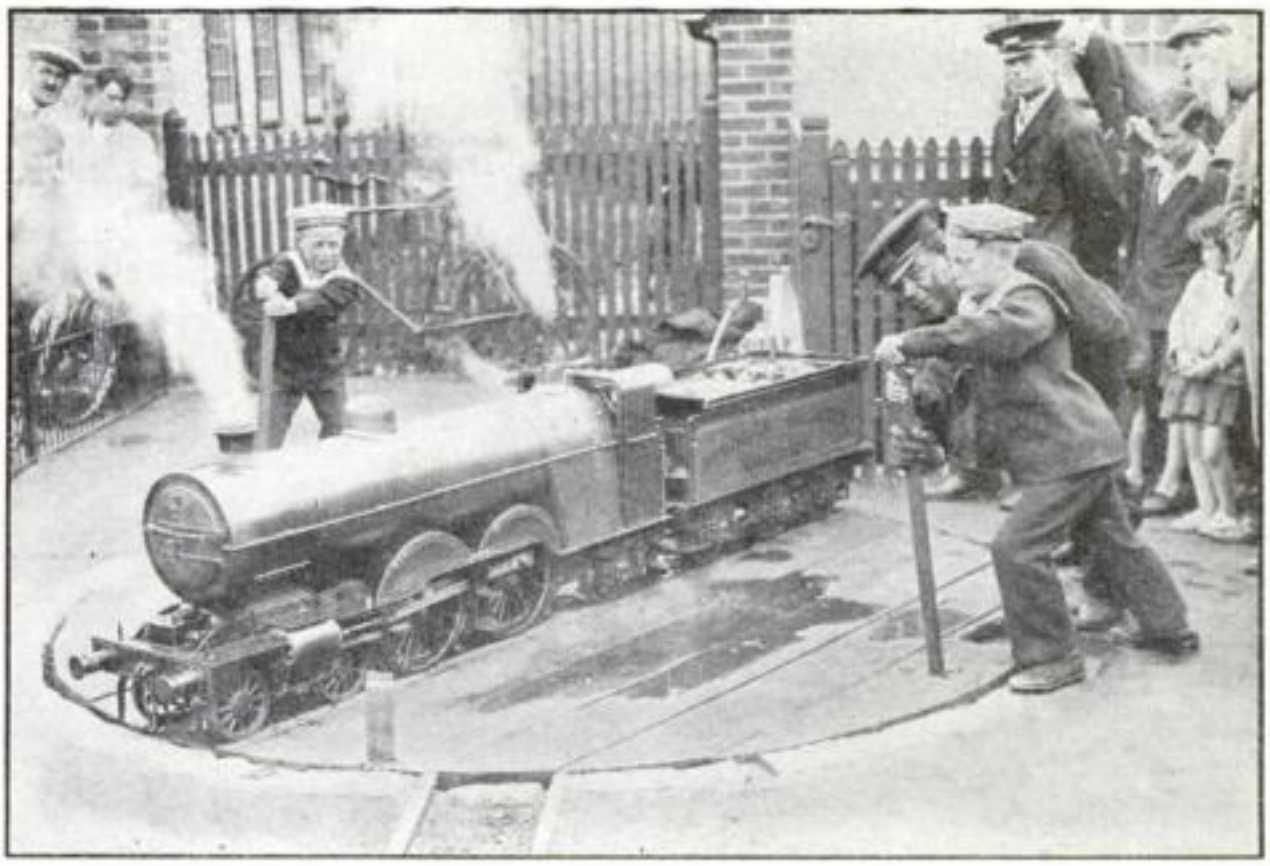
PLAN TOWER 2,000 FEET HIGH FOR WORLD'S FAIR

DWARFING any structure ever built by man, a tower of steel and aluminum more than 2,000 feet tall has been proposed for the 1933 World's Fair at Chicago. Frank A. Randall, Chicago consulting engineer and originator of the project, says such a tower is practicable from an engineering standpoint, and could be erected within seven months to serve as an attraction for sightseers. His design, shown above, outwardly resembles that of the Eiffel Tower of Paris, but the new tower would be double the height of that structure, and top the Empire State Building by 813 feet.

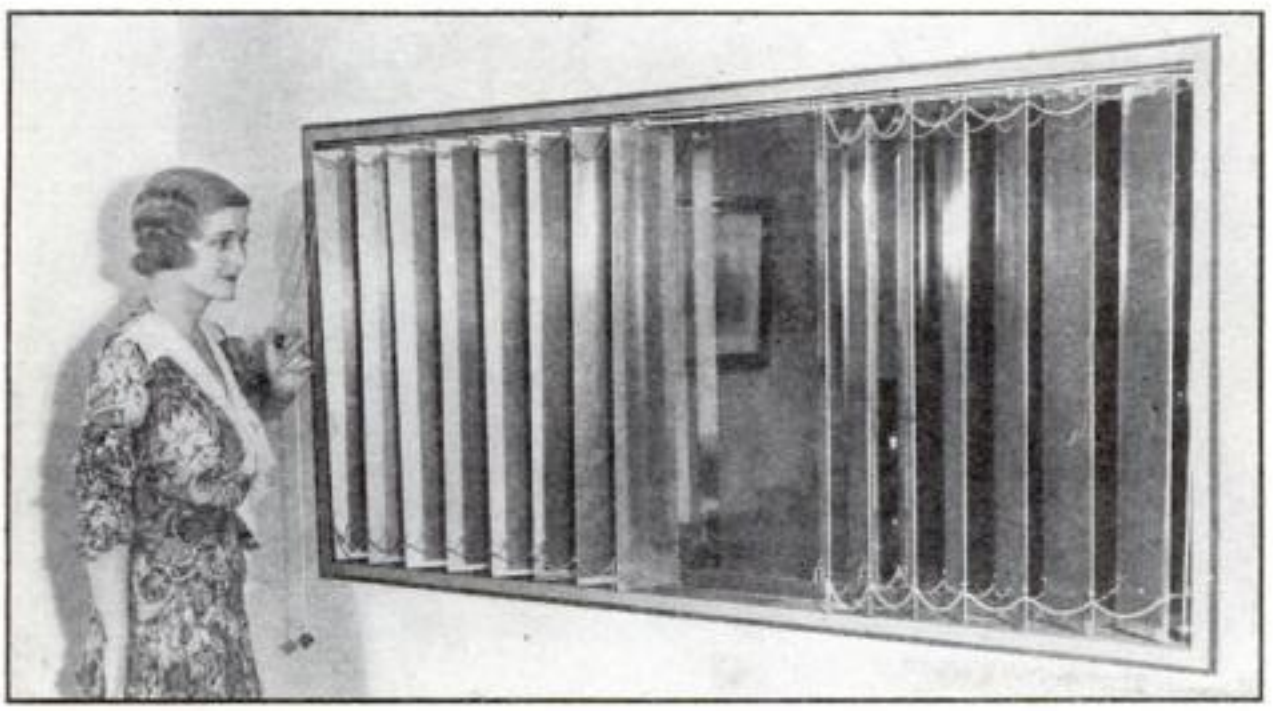
WATER BAG AND PUMP FOR FOREST RANGERS

A FOREST ranger becomes a one-man fire department with the aid of a new portable water bag. Carried on the back like a knapsack, it is made of processed cloth and holds more than five gallons of water for quenching a small blaze. A hand pump forces a strong stream of water from the small nozzle.

TINY RAILWAY HAS TURNTABLE

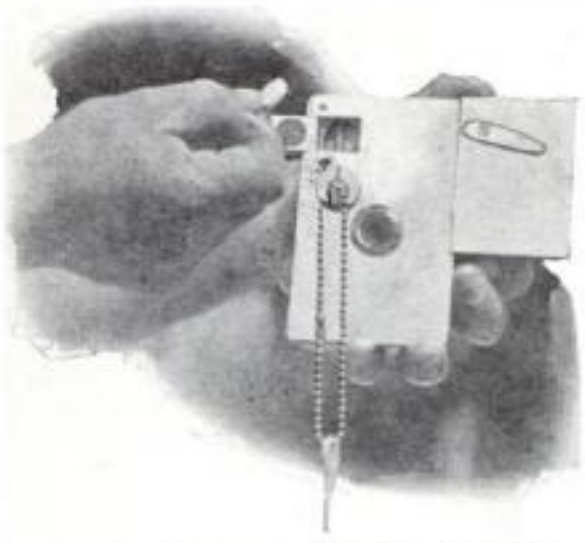


COMPLETE even to a turntable is a miniature railway system just completed at Southsea, England, and said to be the smallest passenger-carrying railroad of its kind in the country. Its rails are of nine and a half inch gage. Trains are towed by model locomotives patterned after those that draw the crack expresses of British lines. Enthusiastic youngsters need no urging to lend a hand in operating the diminutive turntable, shown in the photograph above.



METAL WINDOW SHADES EXCLUDE STREET NOISES

ALUMINUM window shades, setting a modern note in interior decoration, have recently been perfected. According to the maker, they banish the nuisance of balky curtain rollers and soiled shades. The metal panels open or close at the touch of a cord, as illustrated at the left. They are said to be especially suited for use, not only in homes where quiet is desired, but in executive offices, excluding noise and insuring privacy during a conference.

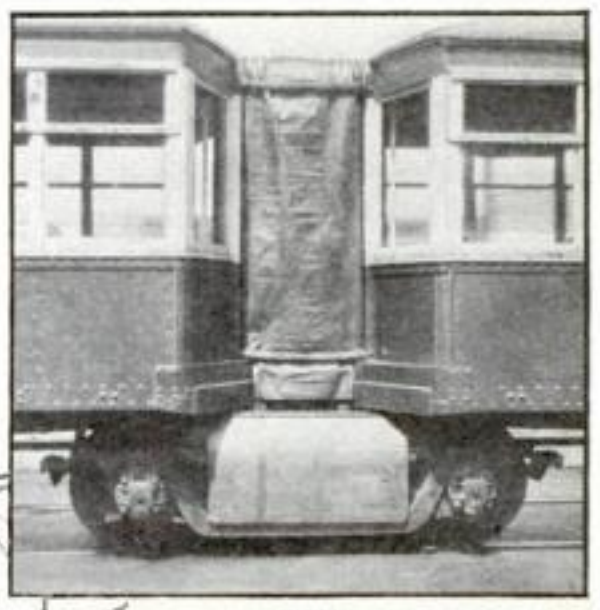


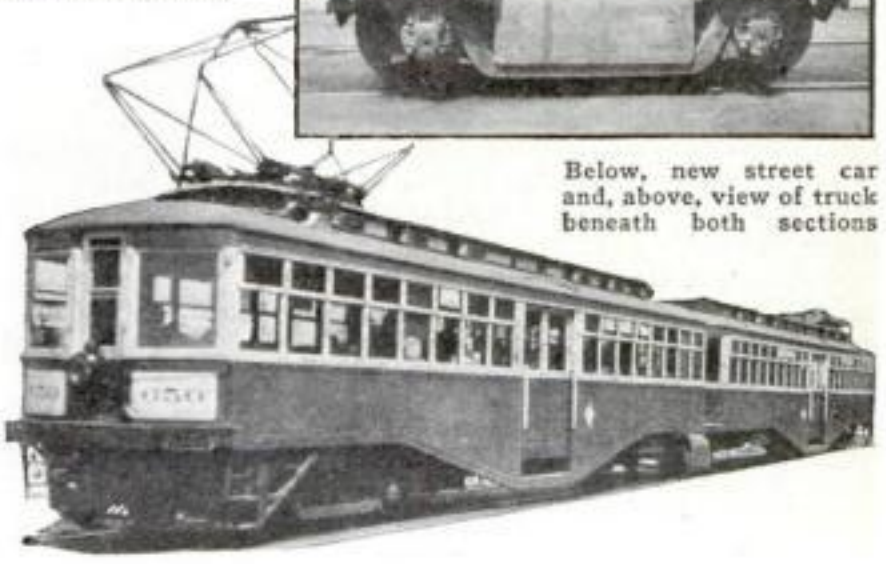
SLUG OPENS NEW LOCK

COIN-SHAPED tokens, as well as a key are needed to open a new lock for warehouses, garages, and office buildings. Each employe's tokens are individually marked. Dropped in the slot, as shown above, they reveal who used the door last.

DOUBLE STREET CAR HAS HINGE IN THE CENTER

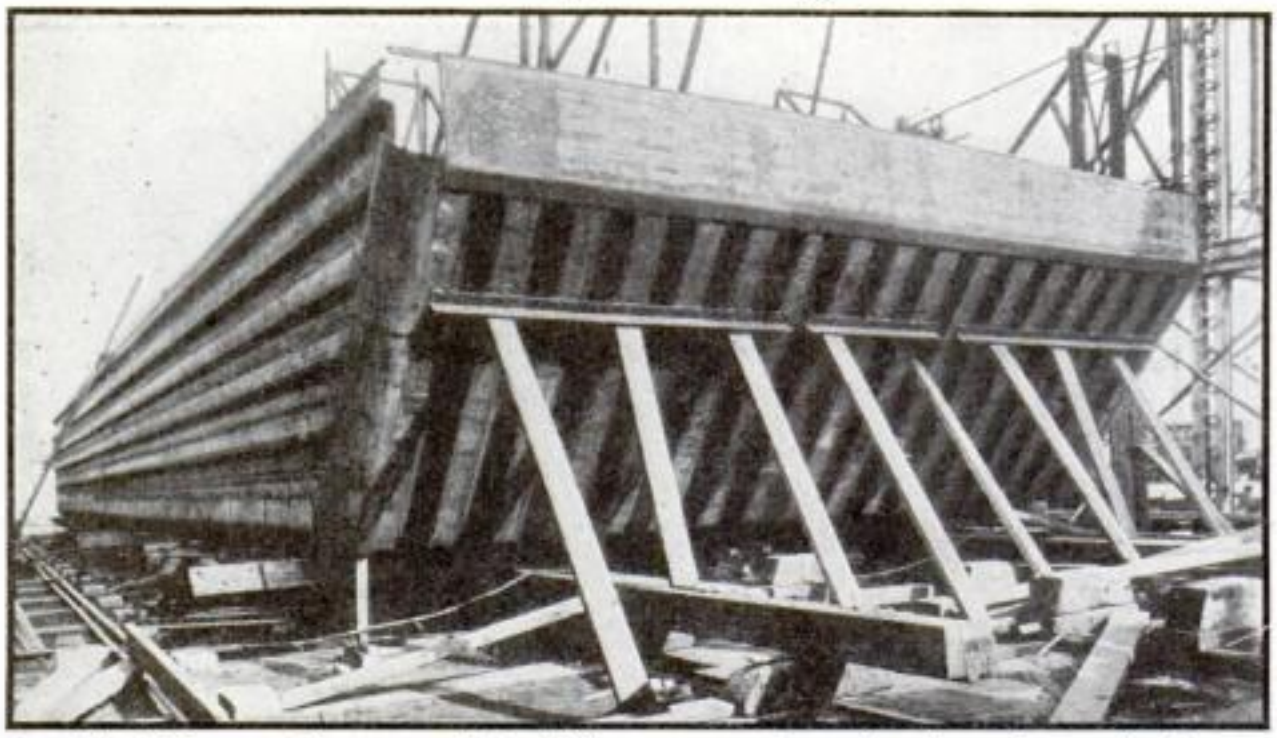
AN ODDITY in rapid transit is a two-in-one interurban car recently placed in service on a northern California line. The two hinged sections look like separate cars, but actually share a common truck at the center. Passengers enter and leave at the front end, where the conductor collects the fares. The rear section is reserved for smokers, and connects with the forward car through a vestibule. Two conductors and a motorman were required on a two car train before the introduction of the new combination units.





Below, new street car and, above, view of truck beneath both sections

New Coal Barge Corrugated to Give It Unusual Strength



This 1,200 ton coal barge was designed like a corrugated paper box in an effort to give it more than ordinary strength without increase of weight. Photo shows it nearing completion

IN DESIGNING a 130-foot, all-steel coal barge, recently launched by a New York shipbuilder, the principle that gives strength to a corrugated paper box was employed.

The new method, called "reverse channel" construction and combining unusual strength with minimum weight, was worked out by Johannes Kjekstad, welding engineer. Instead of pressing corrugations into the sides of the boat, or running a huge plate through a gigantic mill, the same effect was achieved by welding together standard steel channel beams with their flanges facing alternately in opposite directions. Although the added surface increases resistance at high speeds, operation tests are said to have shown that at barge speeds the effect is negligible. In case of grounding or collision, the shell will have a tendency to stretch out, accordion-fashion, according to the makers.

Above, welding steel channel beams together in the barge. Left, cross-section of channel

AUTOMATIC SPEED SIGNAL FOR AUTO AND PLANE

A "SIGNALLING speedometer" has been invented by a Pasadena, Calif., architect automatically to warn motorists and aviators when they reach a predetermined speed, by giving an audible signal or lighting a lamp. The automobile model would be connected to the transmission, and would assist a driver to keep within legal speed limits. Adapted for airplane use, the device would operate from a venturi tube, a device that gages air speed. It would aid a pilot in judging when his plane has attained take-off speed.

EXPOSURE METER GIVES TIME FOR ENLARGEMENT OF PHOTO

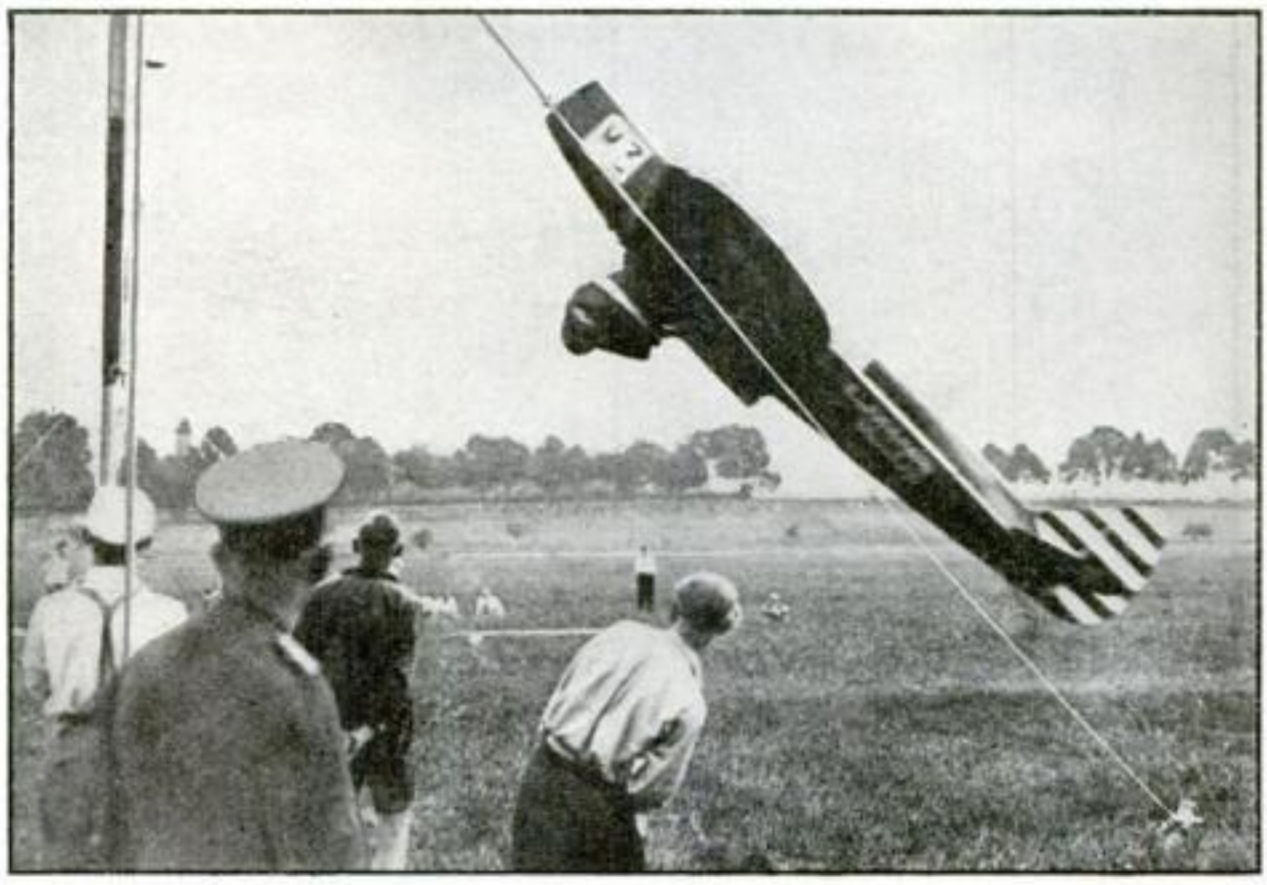
AMATEUR photographers know the difficulty of judging the density of a film or plate negative and timing the exposure correctly for an enlargement. An electrical "enlargement exposure meter" has recently been placed on the market. The user holds it against the easel and presses a button, illuminating a small window. Then he turns a rheostat knob until the brightness of the window matches an adjoining area, illuminated only by light from the enlarging lantern. The correct exposure, corresponding to the knob setting, is then read from a table, and is given for six standard grades of enlarging paper.

CAP ON TUBE SPREADS SHAVING PASTE

FOR the convenience of those who use shaving creams of the non-lathering type, a special applicator has been invented to replace the standard cap on the tube. This new spreader cap applies the paste directly to the face; it is unnecessary to get the fingers greasy. With the cap slightly unscrewed, a gentle squeeze forces the desired amount of paste through a hole and onto the flat spreader. When the cap is screwed down tightly after use, it effectively seals the tube. By the use of this spreader, less time is required to shave.

Plane in Test Climbs at Forty-five Degree Angle

How steeply can an airplane climb? To find out, experimenters at a Berlin airport recently set up an inclined metal wire at a predetermined angle. Skimming near the ground in his high-powered monoplane, P. de Angeli, noted Italian pilot, zoomed directly behind the standard. The picture at the right shows one of his spectacular forty-five-degree zooms, with the tail of the machine barely clearing the ground. To perform the maneuver, the highest type of piloting was demanded.



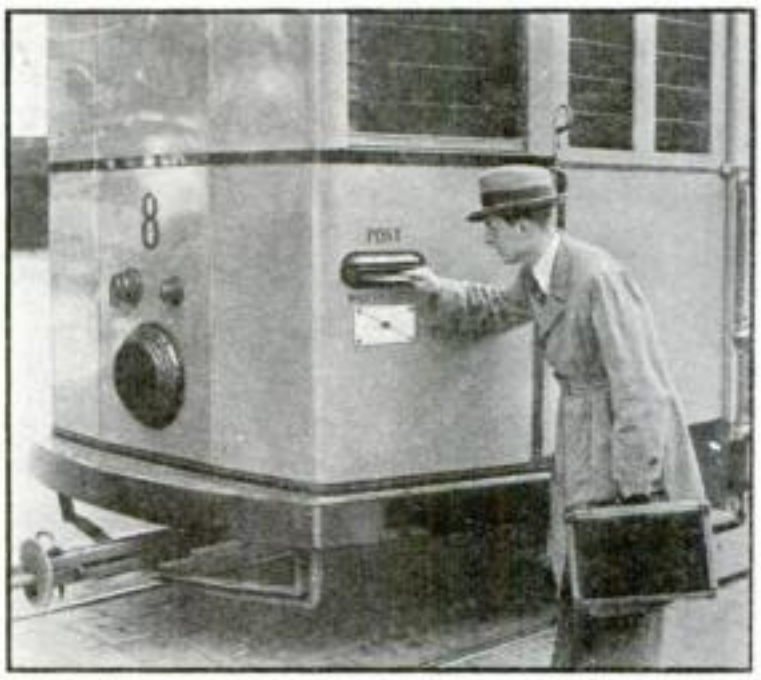
This powerful monoplane, flown by an Italian pilot, is able, as this picture shows, to climb at an angle of approximately forty-five degrees, as indicated by the wire near it

At right, one-hand cigarette case and lighter opened to show how it works. Below, extended cigarette is lighted as the smoker puffs on it

ONE-HAND CASE OFFERS AND LIGHTS CIGARETTE

A ONE-HAND pocket case that delivers lighted cigarettes is the latest aid for smokers. Invented by a San Francisco man, the new case holds nine cigarettes. The mechanism is operated entirely with one hand. A slight pull on the top of the case snaps on the lighter, concealed at one side, and partially extends a cigarette. The smoker takes the cigarette between his lips, gives one strong draw, and it is lighted. The lighter is extinguished by sliding a snuffer over the flame-opening. As a cigarette is extracted, a spring forces a new one into its place.

STREET CAR LETTER BOX SPEEDS MAIL



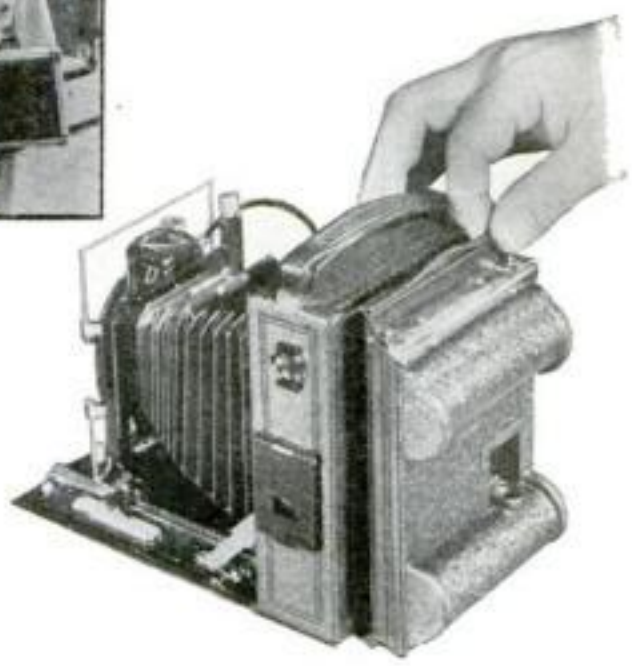
As a convenience to the residents of Strausberg, Germany, letter boxes have been put on street cars

MAIL boxes on street cars have made their appearance in Strausberg, a little town near Berlin, Germany. Now residents may post their letters at any car stop if no other receptacle is near at hand. But it is not recorded whether any person has had the temerity to hail and stop a car for the sole purpose of getting his letter started for its destination.

NEW WINDOW GIVES ONE-WAY VISION

WHEN a pane of new material is mounted in a window frame, a person on the inside can see through it, but one outside cannot see in. From the exterior, the one-way pane resembles an ordinary mirror. Chicago police are reported to employ such a pane to enable witness to identify criminal suspects without meeting them face to face. Banks and business offices also find use for the device.

Woman looking through the one-way window pane can see the man, in circle, but he is unable to see her. Police are using the new pane to hide witnesses from prisoners they identify



FILM CAN NOW BE USED WITH A PLATE CAMERA

EQUIPPED with a new adapter, a plate camera can use roll film. The device that accomplishes this fits upon the back of the camera in place of the plate holder and accommodates a spool of standard roll film. Since the film is arranged to lie exactly in the position formerly occupied by a plate, the regular focusing scale of the camera can be used. The change from plateholder to film adapter requires only a second or two.

Latest INVENTIONS *for the* Household

BLIND, BUT RIGHT. This coffee container not only automatically seals itself tightly when closed, but it also releases exactly the right amount of coffee for one cup so that it can be operated without mistake by a blindfolded woman

WATER-COOLED AIR. A fabric covered wheel in front of this fan is saturated with water and as it revolves in the fan's breeze, the water is evaporated thus cooling the air and adding greatly to the efficiency of the fan as a humidifier

PICKS UP NEEDLES. Fumbling for a needle or a paper clip in a tray in which there are pins, is unnecessary if you have one of these clever ducks. The duck's bill is magnetized so that paperclips and needles will cling to it

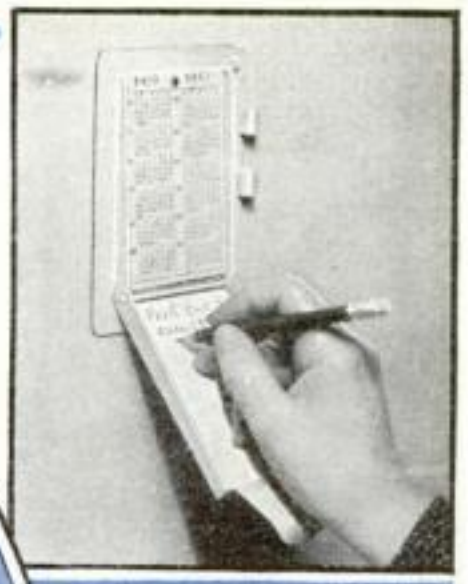
GAS FREEZES CREAM. No electric power is used in this new icecream freezer. In it the work is done with carbon dioxide gas and turning the handle freezes cream in three minutes

STOPS SHIVERY CHILLS. Wiring keeps this screen at the temperature of the human body and when placed between a user and a cold window, it prevents loss of body heat by radiation

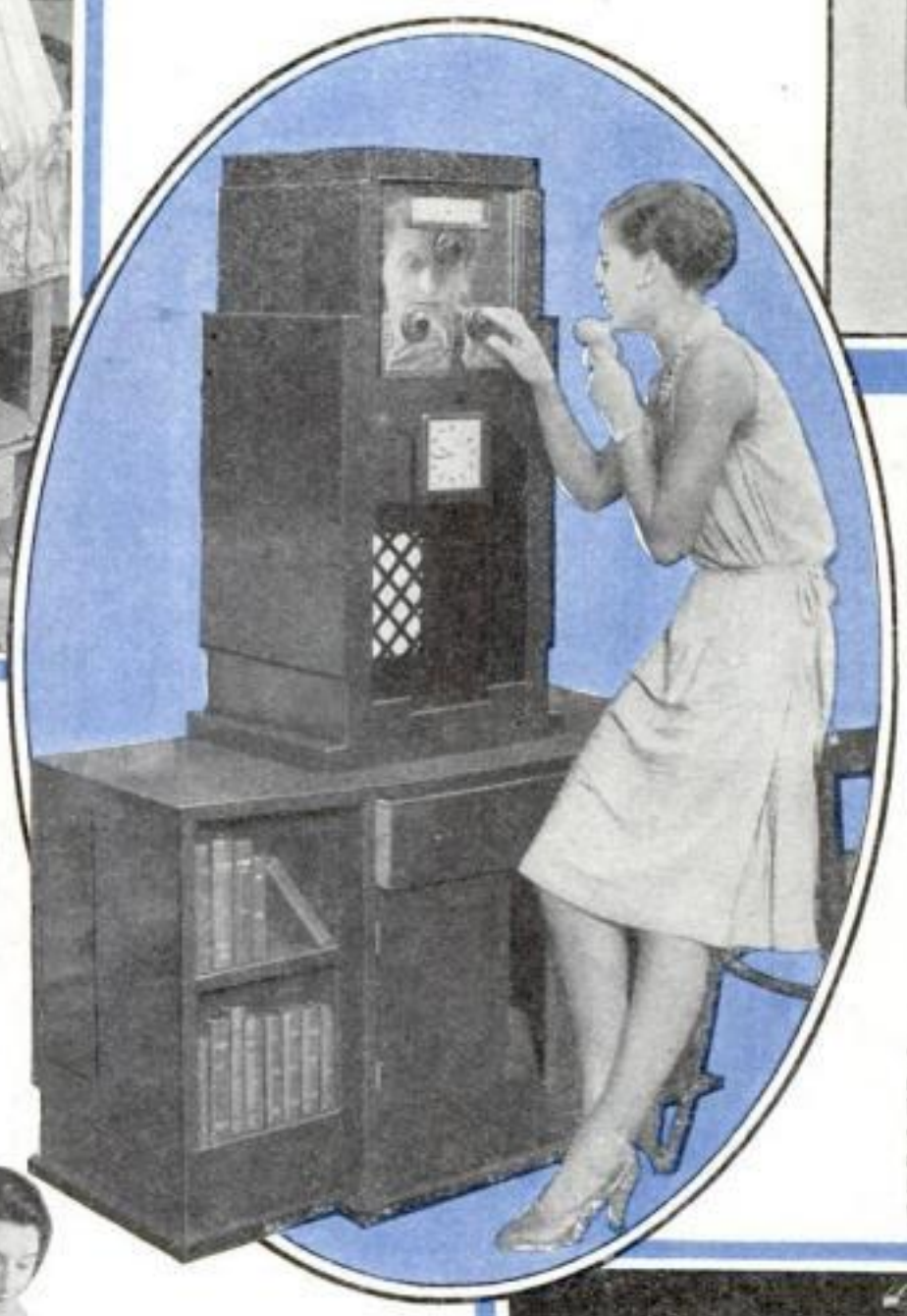
BUTTON CLEANS PAD. Beneath the celluloid surface of this memorandum pad is a sheet of carbon upon which message appears. Pressing button cleans carbon and brings new sheet up

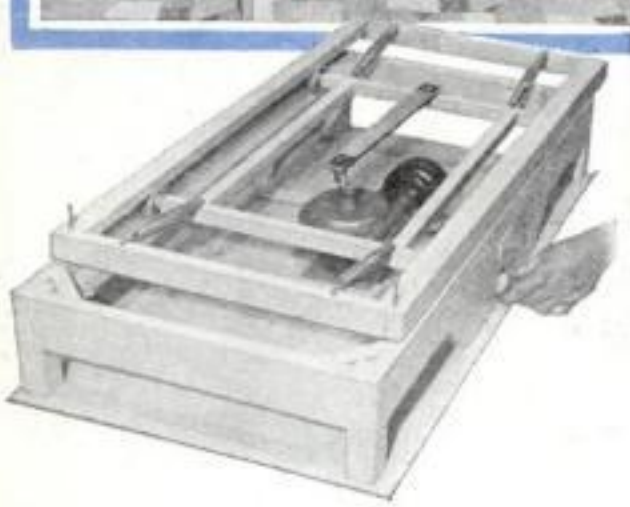
GRAPEFRUIT CAN'T SQUIRT. Sharp prongs on the disk seen at left, are pressed into grapefruit, breaking cells so juice flows without squirting

MORE THAN A RADIO SET. Below is a radio set plus, as it contains a mirror, an electric clock, bookcases, drawers, and a cabinet space providing storage room for many odds and ends



A FOLDING PAD. This pad for kitchen or phone folds shut with the message inside it and is held closed by the pencil which slips through holders seen at the side of pad





CRADLE ROCKS ITSELF. It is no longer necessary to rock baby's cradle as the motor in the one shown does the work. Note that cradle can be removed from the rocking mechanism

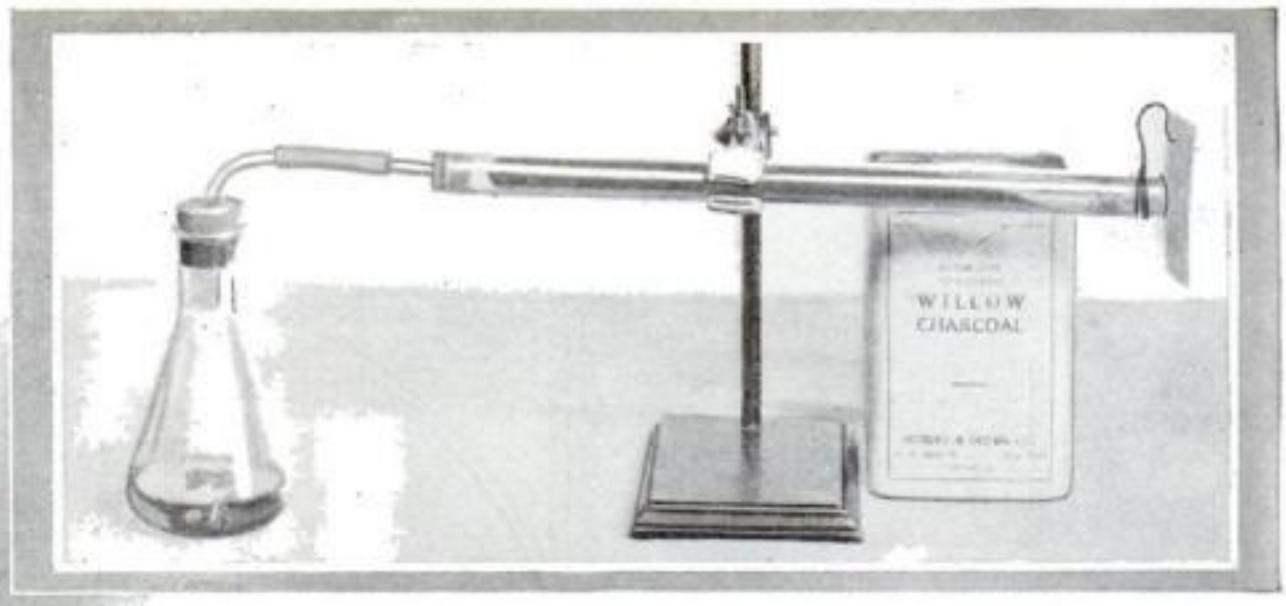
FOR THE SHOWER This new shower head releases only two streams but it covers with less water, the same spread, as the ordinary head. It is easily cleaned as the turn of lugs frees head

TUBES ARE HANDY. This tube rack snaps to the lower side of any shelf and will hold five tubes on a revolving carriage so that any tube is easily reached by swinging the device around

SAFETY CLOTHES WRINGER. Upright guards on each side of the clothes wringer, shown at right, release the tension instantly if they are either pushed or pulled. Hence, there is no danger of injury to the user and clothes are protected from tearing if they should catch while passing through wringer

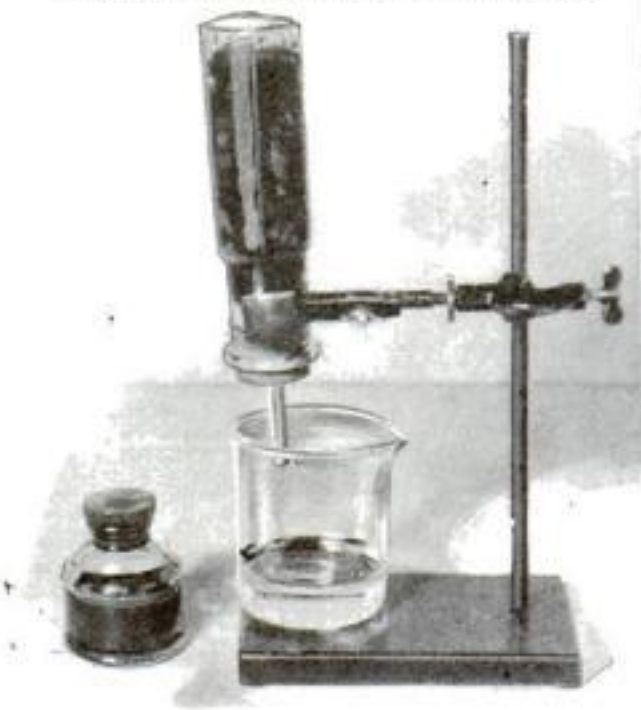
WAX FOR FLOORS. A wax that is applied to a clean floor with cloth or lamb's wool, needs no polishing as it dries with a bright, hard, glossy surface that can be washed without injuring polish

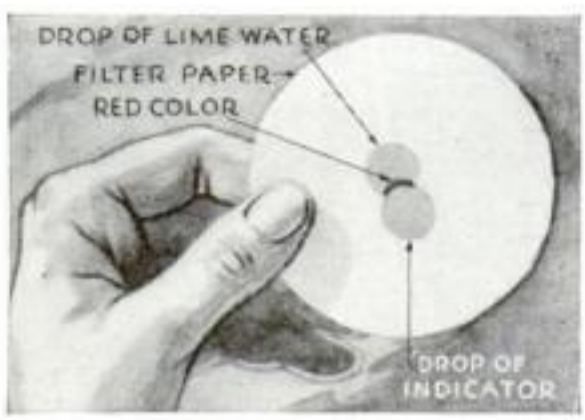
STRAINER DOESN'T TIP. The small wooden knobs, seen on the orange juice strainer at left, serve to balance it when placed across a glass so that it cannot tip and spill the juice



3 Hydrogen sulphide gas, generated in the flask by the action of acid on iron sulphide. Gas is passed through the long tube filled with charcoal, which adsorbs it as is proved when paper at end of filter tube shows no trace of black

1 Apparatus, below, consists of bottle filled with charcoal and cotton into which ink is poured. Through glass tube in cork, ink drips out clear, carbon having adsorbed all the coloring pigment





2 To show action of adsorption, place drop of lime water on filter paper. Adjoining this place drop of phenolphthalein solution. After the drops spread into each other, a red crescent will appear where the drops overlap

Experiments with CARBON *for the* Home

By RAYMOND B. WAILES

IF YOU had your choice between burnt toast and a diamond, you undoubtedly would choose the diamond. Chemically speaking, however, you would be getting carbon in either case. The burned, black portion of toast is carbon, while the diamond is carbon in a crystalline form. Do not be misled into believing that all crystalline forms of carbon are valuable for the only other crystalline form, graphite, is not highly prized and you will find it in every lead pencil and in every can of stove blacking.

Thus, you see, carbon may be found in vastly different forms. This fact will not surprise you when you realize that it constitutes more than two-thirds of the 300,000 known chemical compounds. So numerous, indeed, are the uses and properties of carbon, that the special name of Organic Chemistry has been given to the study of its compounds.

Although the forms of carbon are so numerous and differ so greatly in color, hardness, and density, all are identical chemically. Heated and placed in oxygen they burn with a vivid flame to form carbon dioxide gas. In fact, so readily does carbon combine with oxygen that under certain conditions it steals the oxygen from oxygen-containing substances called oxides.

With the simply arranged apparatus shown in Fig. 6, the amateur chemist can easily demonstrate this breaking down action of carbon on oxides. A mixture of black copper oxide and powdered charcoal is placed in the test tube and heated. The heated charcoal, combining with the oxygen, changes the copper oxide to copper and forms carbon dioxide gas. This gas can be recognized by the fact that if it is led through the outlet tube into a beaker containing clear lime water, it turns the lime solution cloudy. The free copper remains in the test tube as a bright powder. This removing of the oxygen from a compound is called "reduction," and the substance from which the oxygen has been removed is said to have been "reduced."

Another valuable property of carbon, and one that makes the gas mask possible, is its ability to remove noxious gases from the air by adsorption. Adsorption is the property of a solid that causes gases and other substances to cling to its surface. The extremely porous nature of carbon makes it particularly adsorptive. A good sample of charcoal is capable of adsorbing several hundred times its own volume of ammonia. In the manufacture of gas masks, an extremely porous form of charcoal made from fruit pits is used.

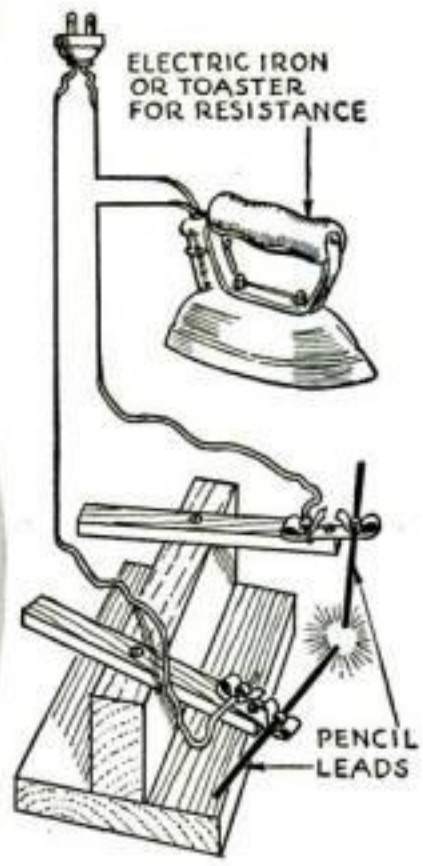
AN INTERESTING and instructive experiment showing the adsorptive properties of charcoal can be easily performed in the home laboratory. A glass or metal tube, filled with charcoal, is connected, by means of a cork and tubing, to a flask in which by the action of a dilute acid on iron sulphide, hydrogen sulphide gas is being generated.

In experiments dealing with the sulphur compounds (P. S. M., Sept., '32, p. 50) it was found that hydrogen sulphide gas has a distinguishing rotten egg odor and that it can be definitely recognized by the fact that paper, moistened with either lead acetate or copper sulphate, is colored when brought in contact with it. As in Fig. 3, lead acetate paper is placed at the outlet of the charcoal filter tube to detect even the slightest trace of the gas, but it remains colorless showing that the charcoal has effectively adsorbed the hydrogen sulphide.

ANOTHER experiment, showing graphically the action of adsorption, consists of allowing a drop of lime water to fall on filter paper or a piece of blotter. Adjoining the spot of water place a similar drop of phenolphthalein solution. This drop will spread into the first spot and some time after the two spots have spread into each other, a red crescent will appear where the two overlap. The lag between the visible overlapping of the two spots and the formation of the color is caused by the fact that the water in both solutions creeps through the fibers more rapidly than the chemicals which are adsorbed by the paper.

Phenolphthalein can be purchased in alcohol solution for a few cents from any druggist and can be conveniently stored in a dropping bottle. Its real value lies in its ability to indicate the presence of a base or alkali, such as lime water or calcium hydroxide, by changing to red or pink. Because of this property it is referred to as an "indicator."

The same property that causes carbon to adsorb toxic gases makes it useful as a filter for removing coloring matter from substances. Commercially, bone-black, another form of carbon, is used in sugar refineries to remove the undesired color from sugar solutions. Fountain pen ink, diluted with water so that it is somewhat weakened in color, can be changed by the



4 Wiring diagram showing how to set up small arc lamp, illustrated at left. Strips of wood are fastened to block so they can be adjusted while clips hold ordinary pencil leads. When current is turned on, the leads will get hot, and if slightly separated will glow

5 With ammonia water in flask, a wad of tissue paper is inserted and over this a spoonful of powdered charcoal is poured. As charcoal adsorbs ammonia gas, the water in the beaker will rise through the tube connection, proving that the adsorption of gas by the charcoal has created a vacuum in the flask

Chemist's Laboratory

home experimenter into a colorless liquid by filtering it through charcoal in the manner illustrated in Fig. 1. An olive bottle forms a neat funnel for this experiment.

IN ONE end place a cork fitted with a glass tube. Then place a wad of cotton in the bottom and fill the bottle with charcoal. Ink poured in at the top will drip from the outlet tube at the bottom a colorless solution. If the ink is greatly diluted, this experiment can be carried through by using an ordinary glass funnel fitted with filter paper containing charcoal.

As already pointed out, charcoal adsorbs ammonia with great avidity. This can be shown by placing a tablespoonful of strong "ammonia" or ammonia water in a small flask or bottle fitted with a stopper and outlet tube as in Fig. 5. After allowing sufficient time for the ammonia gas given off by the ammonia water to displace the air in the bottle, drop in a wad of tissue paper and on it pour a tablespoonful of powdered charcoal. After quickly inserting the stopper, place the end of the outlet tube in a small beaker of water.

If all the connections are airtight and the ammonia water strong enough, the water in the beaker will be drawn up in the outlet tube showing that a vacuum is being formed inside the flask by the adsorption of the ammonia vapor by the charcoal. If the charcoal is heated and cooled in a stoppered bottle before the experiment, the rise of water in the tube will be more rapid. This same experiment can be repeated, using hydrogen sulphide gas to illustrate the removal of odors from the air by the use of charcoal. The tissue paper is used in this experiment to prevent the charcoal from coming in contact with the ammonia water.

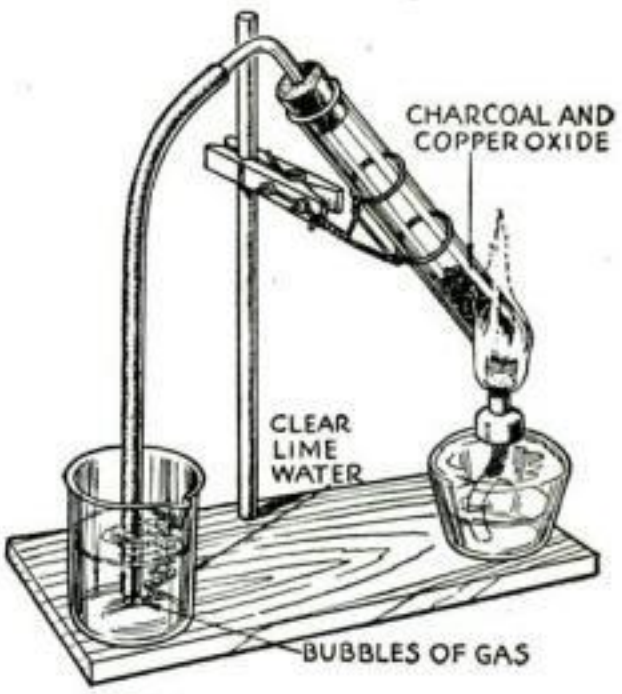
Charcoal is also valuable as a filter for removing odors and tastes from water. Hydrogen sulphide water, unmistakable because of its characteristic odor, can be made odorless by filtering through charcoal. Similarly, the bitter taste imparted to water by dissolving a quinine tablet in it can be removed by a charcoal filter.

Sugar, when heated, first melts and chars to form caramel but on further heating changes into one of the purest forms of carbon. A striking experiment illustrating the preparation of charcoal from sugar can be performed by adding concentrated sulphuric acid to a strong solution of sugar and water. The sulphuric acid decomposes the sugar water to form carbon which flows forth from the container in a foamy, pasty mass. Although wasteful of acid, the experiment is quite harmless providing the usual precautions are taken to keep the hands and clothing away from the acid.

JUST as oxygen combines with metals to form oxides, carbon reacts with metals to form carbides. Calcium, for instance, unites with carbon to form calcium carbide. Cast iron has carbon particles imbedded in it and chemically combined with it. A small piece of cast iron when dissolved entirely in muriatic acid leaves behind black particles of carbon.

Lampblack, a form of soot like that given off when a kerosene lamp smokes, is practically pure carbon. The hydrogen in the oil burns but much of the carbon, because of a lack of oxygen, remains unburned and is deposited on any cold surface with which it comes in contact. Commercially, lampblack is used in the manufacture of paints and inks.

Although obtainable from natural deposits, graphite is also produced artificially



6 Black copper oxide and powdered charcoal are placed in test tube and heated. Hot charcoal combines with oxygen, changes oxide to copper, and forms carbon dioxide gas

by heating anthracite coal in an electric furnace capable of producing an extremely high temperature. The graphite crystals appear as smooth plates or scales and it is this smoothness that makes graphite valuable as a lubricant. Artificial graphite can also be produced in the form of a fine powder that will remain suspended in water or oil.

Like all forms of carbon, graphite is practically infusible, making it useful as a material for crucibles used in the melting of metals. Like the diamond, graphite burns only at extremely high temperatures.

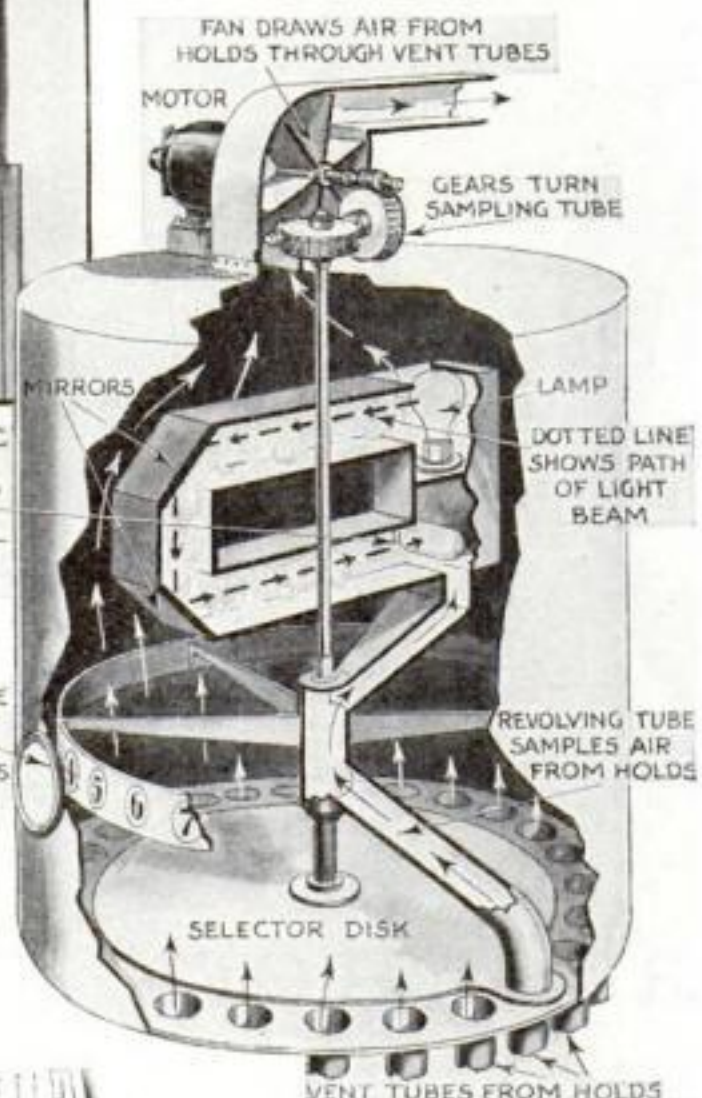
For use in pencil leads, graphite is mixed with clay in varying amounts depending on the hardness desired.

Graphite differs from the other forms of carbon in that it is an excellent conductor of electricity. Thus it finds important application in the electro-chemical industries where it is used as electrodes. Also, since carbon in any form will not melt, graphite forms an excellent material for the electrodes of an arc lamp.

Pencil leads can be used by the home experimenter in a small experimental arc lamp. The house lighting circuit, connected with some electrical appliance such as a flat iron, toaster, or heater, is used as the current supply. *(Continued on page 93)*

FINDS A FIRE AND SIGNALS WARNING. Designed especially for use on big liners, the fire detector, left, will sound an alarm at the first appearance of a wisp of smoke and also reveal numbers giving the exact point at which blaze started

Drawing, right, shows interior construction of the automatic fire detector, the heart of which is an electric eye. Below, breakaway view showing how detector is installed for use in a big ship



Electric Eye *sounds* Fire Alarm *and* Locates Blaze *on* Ship

DISASTERS such as the recent burning at sea of the French passenger steamship *Georges-Philippar,* with the loss of dozens of lives, may be averted in future by an automatic fire alarm system perfected especially for marine use. Not only does this apparatus sound an alarm when the first wisp of smoke anywhere in the ship indicates a fire, but it reveals the exact location of the fire in time to prevent it from gaining headway.

The heart of the apparatus is a photo-electric cell or electric eye within a "sampling chamber," through which a suction fan draws air from the holds of the vessel. A beam of light from a small lamp is directed with mirrors upon a circuitous course through the chamber until it falls upon the sensitive cell. So long as the beam is uninterrupted, nothing happens. When smoke in the air cuts off the light beam, however, the photo-electric cell operates an electric relay and sounds the alarm. Even the merest trace of smoke reduces the intensity of the light beam and operates the alarm.

Vent tubes radiate from the fire detector to each of the ship's holds where a fire might conceivably start. Samples of air are drawn in turn from each tube through an ingenious "selector disk" bearing a revolving collector, as shown in the diagram. The disk also carries a numbered ring, the numbers corresponding to the individual holds. When an alarm sounds, the disk automatically stops, and the location of the fire is read at once through a window in the side of the detector. The officer on the bridge then orders the fire-fighters into action, or operates mechanical extinguishers if the ship is provided with them.

Cash Prize WINNERS *in our August Heroes of Science Contest*

Here Are the Names of Twenty-Nine Whose Skill and Application Brought Them Cash Rewards in Our Big Picture Cutting Contest in August Issue

FIRST PRIZE $500

Charles Lind, Hicksville, N. Y.

SECOND PRIZE $100

H. J. Brockman
Baltimore, Md.

THIRD PRIZE $50

M. J. Langley
Chicago, Ill.

SIX $25 PRIZES

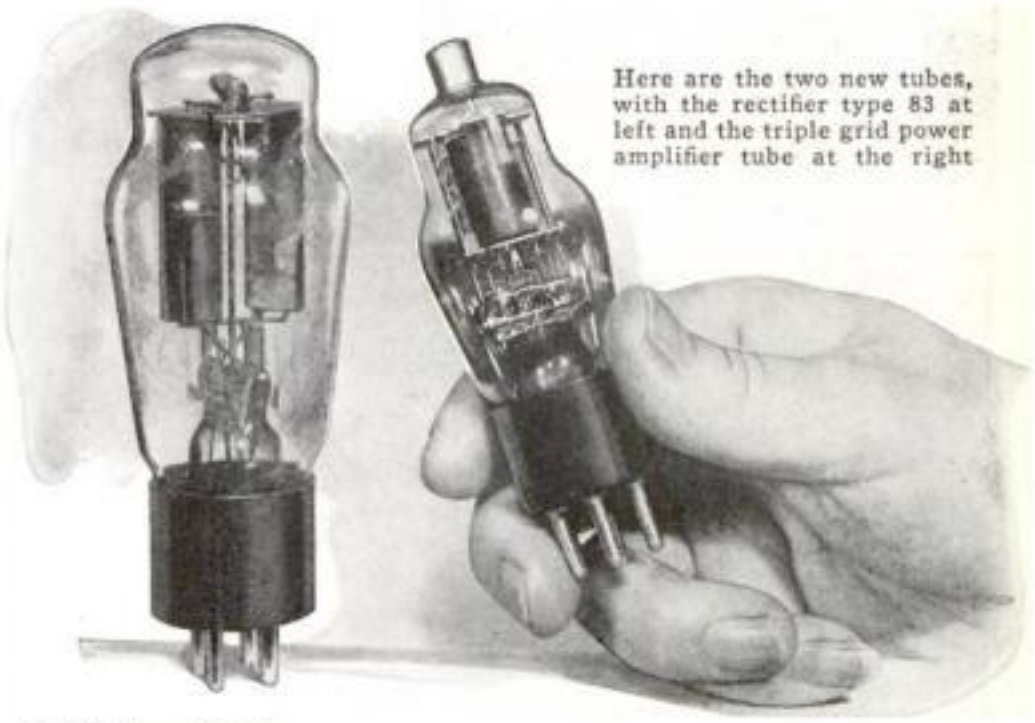
V. Branthoover, *Brackenridge, Pa.*
Frank P. Conrad, *Toledo, Ohio.*
C. Muchlichen, *Woodside, N. Y.*
F. Sabatini, *Brooklyn, N. Y.*
J. F. Smolen, *Bronx, N. Y. C.*
Glen McWilliams, *Van Dyke, Mich.*

TWENTY $10 PRIZES

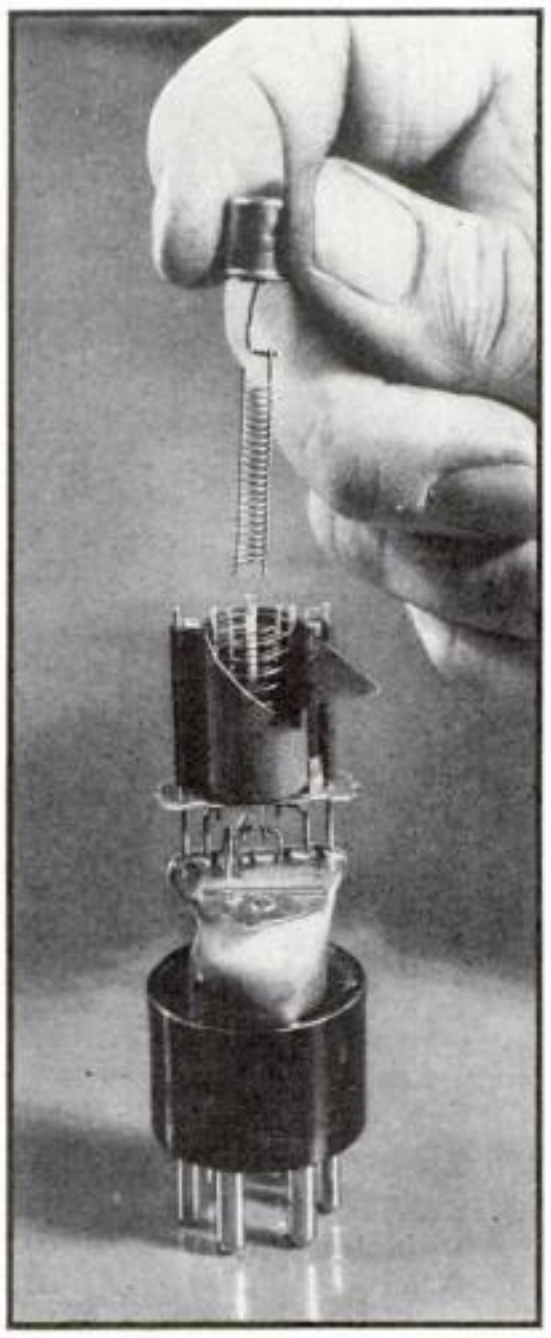
R. Albrecht, Jr., *Cincinnati, Ohio.*
J. M. Bosanic, *Milwaukee, Wisc.*
S. Chemney, *Cleveland, Ohio.*
D. S. Cookingham, *Rhinebeck, N. Y.*
J. A. Davis, *St. Helena, Calif.*
W. F. Druzik, *Pittsburgh, Pa.*
C. Gray, *Brooklyn, N. Y.*
M. C. Hicks, *Chicago, Ill.*
A. G. Kalmbach, *Grand Rapids, Mich.*
G. Marshall, *Toronto, Canada.*
H. A. McDonald, *Louisville, Ohio.*
L. M. Mullers, *Nashville, Tenn.*
R. F. Purdy, *Raton, New Mexico.*
V. E. Phasey, *Fort Meade, Md.*
P. Sapossnek, *Brooklyn, N. Y.*
Laura Shrum, *Pottstown, Pa.*
J. A. Vaughan, *Belleville, N. J.*
Howard Watkins, *Loomis, S. Dak.*
G. T. Welch, *Edgewood, R. I.*
W. A. Werneke, *New York City.*

New Radio Tube Has Three Uses

Changing the Grid Hook-up in Amplifier Type 89 Changes Work It Does in Set



Here are the two new tubes, with the rectifier type 83 at left and the triple grid power amplifier tube at the right



At left, type 89, taken apart so triple grid construction is visible. At center is tiny cathode with inner grid outside it, but pulled up to show construction. Plate is cut and folded back to give clear view of the two other grids

THREE complete grids, each with its own separate connection, give a remarkable radio tube, the new type 89, the ability to change its characteristics as a chameleon changes its colors.

When a tube of low amplification factor is required, type 89, with its grids connected a certain way, becomes such a tube. Hook the grids another way and you get tremendous amplifying power. A third combination makes the tube suitable for use in the latest push-push output circuit that operates without C bias.

Another new tube, the type 83, full wave mercury vapor rectifier, is designed to handle exceptionally heavy and variable loads. It has the astonishing output of a quarter of an ampere at high voltage and also will handle instantaneous overloads up to .8 of an ampere. Compare these new tubes with the best obtainable only a few years ago and the advances that have been made in the vacuum tube become evident. The old 216B, rectifier, for example, which supplied B current to many of the early models, could handle a load of only .06 of an ampere at a fraction of the voltage easily carried by the new type 83.

The new triple grid power amplifier type 89 is particularly adapted to automobile service and other mobile sets where no electric light current is available. It uses a heater cathode rated at 6.3 volts and .04 of an ampere, just .01 of an ampere more than other automobile types such as the 236, 237, and 238. Like them, it will stand any battery voltage fluctuation ordinarily encountered in automobile operation.

Picture at upper right shows both the new tubes, rectifier, type 83, being at the left. Because of the need for separate connections to all three grids, the type 89 has a cap connection in addition to the six prongs on the base. That makes seven separate connections, which is the greatest number that has ever been used on any tube for broadcast reception.

In construction, the new triple grid tube is, perhaps, simpler than some of the previously introduced screen grid types. Photo upper left shows an 89 dissected so that the triple grid construction is laid bare. At the center is the tiny cathode. Outside that is the inner, or number one, grid, pulled up out of place to show the construction more clearly. The plate, a cylinder of carbonized sheet metal, has been slit and a portion folded back to expose numbers two and three grids in the new tube.

The diagram at bottom of page shows how the various elements of the tube are connected to the prongs and cap.

When it is desired to use type 89 triple grid tube as an ordinary amplifier in the audio stage preceding the final or power output stage, grids two and three are hooked to the plate terminal, and the tube is then, in effect, a regular three element tube. The cathode emits electrons that are controlled by the number one grid as they pass through on their way to grids two and three and the plate, all acting as one positive or plate element.

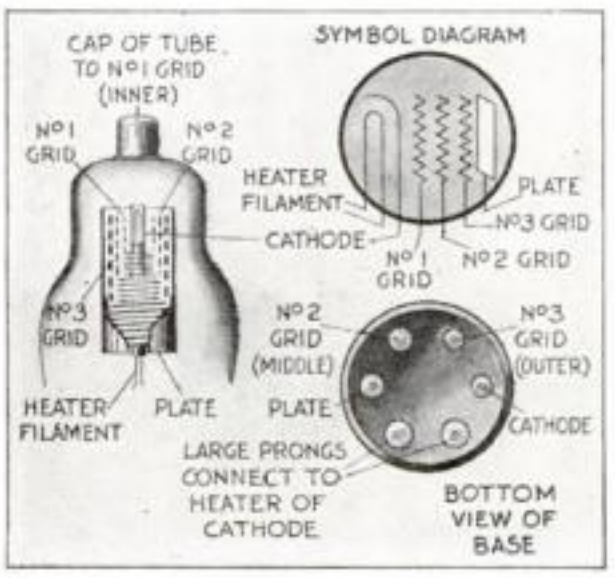


Diagram of type 89 showing how the various elements are connected to the prongs and cap

If it is desired to use this tube as a power pentode of somewhat similar characteristics to type 238, then grid number three is wired to the cathode, grid number two is connected into the circuit as if it were a screen grid, number one the control grid, and the plate functions alone.

Under these conditions, the tube in the last stage has a power output of 1.5 watts as compared with only .3 of a watt when used in the simple three element way.

To use type 89 in the push-push (class B amplification) output stage, grid number three is wired directly to the plate and grids one and two, connected together, form the control grid.

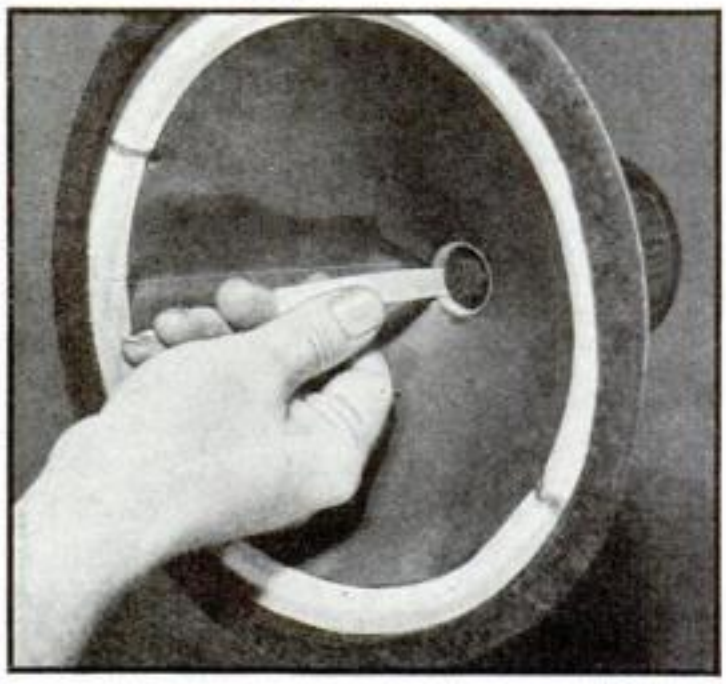
As the tube is designed for use in sets that are subjected to considerable jarring and vibration, mechanical rigidity is an important item. Extra bracing for the assembled elements is obtained in a novel manner. The top of the bulb is domed and the top insulator, of sheet mica, is made in the form of a cross. Its size is such that the ends of the cross just touch the inside walls of the glass dome.

Type 89 should be of especial interest to radio experimenters and students of radio theory because the number of grids, each with a separate connection, permit all sorts of test circuits to be worked out.

The new rectifier tube is of the full wave, mercury vapor type. One of its distinguishing features is the low, and virtually constant, voltage drop. Within its rated load limits, the voltage lost in the functioning of the tube is only fifteen. That means the voltage delivered by the tube will always be just fifteen volts less than the voltage applied to it by the transformer. This holds good whether the tube is working on a heavy or a light load.

A steady, non-fluctuating B supply voltage is of great value in operating the new push-push circuit. The push-push hookup draws many times the amount of current on a strong signal as on a weak one. In fact the current flow in a push-push circuit continually fluctuates even when the volume level is kept constant.

Trailing Trouble *in Your* *Loudspeaker*



At left, method of testing clearance between inside of voice coil and outside of pole piece in effort to detect off-center voice coil. Above, using headphones and dry cell in test for burned out voice coil

Three typical loudspeaker spiders which are used to support the voice coil so it can vibrate freely back and forth

WOBBLING back and forth some eighteen million times for every hour of use, your radio loudspeaker gets a pretty tough deal. No other part of the radio receiving equipment has to stand such terrific mechanical punishment. It is no wonder, therefore, that a radio loudspeaker occasionally breaks down under the strain of so much vibration.

There are many makes and sizes of radio loudspeakers, but they are alike in basic design and they all have similar troubles.

No matter what the shape of the frame or the general appearance of any modern loudspeaker, it is almost sure to be of the dynamic type. That means it contains a powerful electro-magnet, the core of which is circular in section. At the apex of the paper or treated fabric cone, there is a tiny coil of wire wound on a short paper or fibre cylinder. This cylinder is large enough to fit over the end of the magnet core without touching. Various means are employed to hold the small coil centered over the core and yet permit it to move freely back and forth.

The base or edge of the cone always is held to the front supporting ring by means of a rim of soft leather or other equally flexible material. Theoretically, the cone is supposed to vibrate as a unit. In practice it usually does this but vibrations in the cone material also are set up.

The only variation from this general construction is found in some recently introduced light-weight dynamic speakers for use with automobile and small mantel-piece type sets. Some of these are fitted with a permanent magnet in place of the electro-magnet.

Among the possible troubles to which the dynamic speaker is subject are burned out field coil, burned out voice coil, loose connections, broken spider, loose voice coil, loose diaphragm, cracked or split diaphragm, and a warped or off-center voice coil.

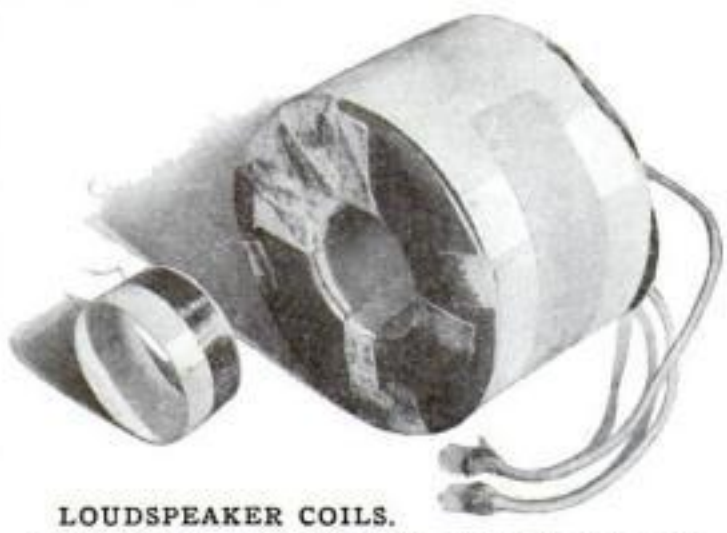
This is a rather imposing list of things that can happen. Fortunately, most of these possible troubles are quite rare.

When your loudspeaker gets sick the first job is to diagnose the ailment. Taking the troubles in the order named, if the field coil burns out, the speaker will still continue to operate, but the volume will drop to such a low level that you can hardly hear it, even with the set volume control turned full on. In fact the only reason you get any sound at all is because of the slight residual magnetism left in the pole piece.

A sure test for field coil operation is to hold the end of a screw driver near the pole piece. It should be strongly attracted to it. If it is not, then either the field coil is burned out or there is a broken connection somewhere in the wires that supply current to the coil.

A burned out voice coil completely silences the speaker. The simplest test is to connect a dry cell and a pair of headphones in series with the coil and listen for the click-clack as you make and break the circuit. If you don't get it, the coil is broken at some point.

A loose connection in the speaker leads results in intermittent operation or in excessively noisy and irregular volume.



LOUDSPEAKER COILS.

At left, the voice coil consisting of a layer of fine wire on cardboard. Right, coil which magnetizes pole piece

A broken spider usually causes chattering noises that are most pronounced at some particular tone frequency. However, if the spider is broken in such a way that the voice coil is allowed to shift out of its central position and so rub against the pole piece, the tone will sound muffled and there may be continuous scratching noises.

A loose voice coil always spoils loudspeaker results and the symptoms will depend on the nature of the looseness. If, for example, the coil and spider have come loose from the cone, a bedlam of chattering will be produced. If it is only partially loose, the chattering is likely to occur only on some particular musical note.

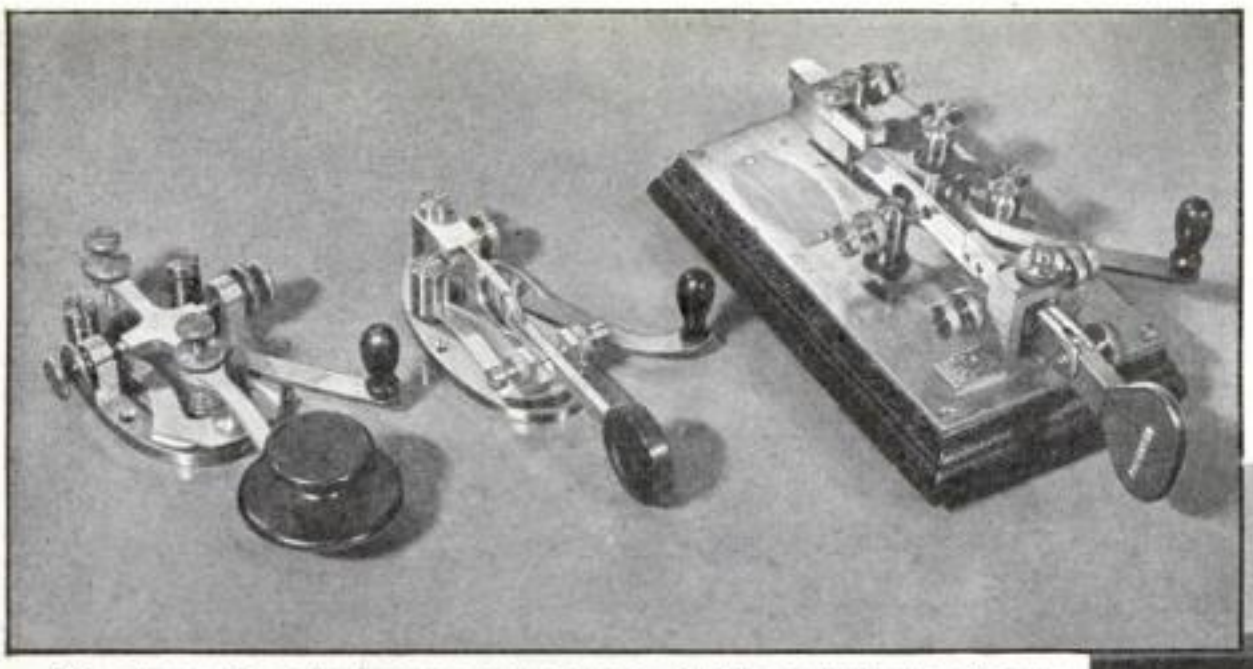
Looseness at the front edge of the diaphragm, or an opened seam or crack in the diaphragm itself, always produces chattering noises. The seat of the trouble often can be located by placing the finger gently on different points of the diaphragm while it is in operation.

You can always detect a warped or off-center voice coil by the method illustrated in the picture at upper left. There should be sufficient clearance between the pole piece and the inside of the coil to slip a piece of writing paper into the crack and move it all around the pole piece.

There are, of course, other troubles that affect dynamic speakers which have been added to older sets as independent units. For instance, in the so-called A. C. type dynamic speaker, which has its own rectifier system for supplying its field current, the dry, or tube type rectifier, may go bad. If that happens, the speaker will act as though it had a burned out field coil.

The cure for any dynamic speaker trouble is to repair or replace the part. It is now possible to obtain any of the separate parts for all popular makes of loudspeakers, either from the original manufacturer or from smaller concerns specializing in this work. Picture, upper right, shows several different types of spiders readily obtainable.

It is not practical to repair a spider as this part has to be made with extreme accuracy as otherwise the voice coil will not be held central.



Three types of keys short-wave amateur may use. At left, regulation up and down type. In the center, side swiper and at right the bug, that makes dots automatically

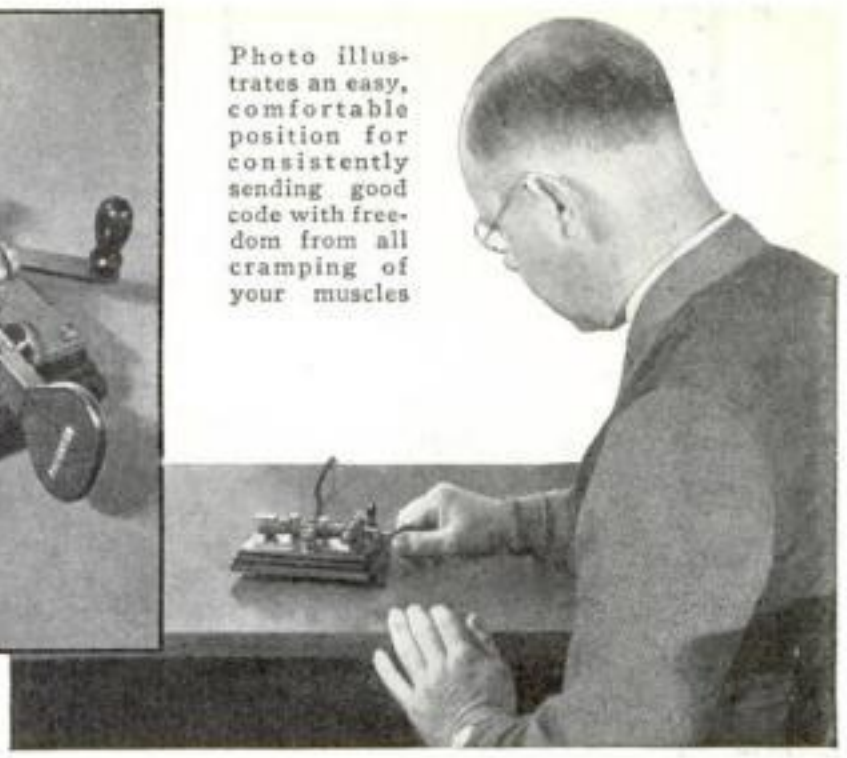


Photo illustrates an easy, comfortable position for consistently sending good code with freedom from all cramping of your muscles

How to get Good Code "FIST"

Efforts at Speed Spoil Amateur's Work in Spite of Type of Key Used

By John Carr

ABILITY to send clean-cut, readable code, a good "fist," is the goal of every amateur radio operator. As you listen in, however, on the amateur wave bands, you will hear the Internation Morse Code distorted, mutilated, and garbled in every conceivable way. There is the fellow who invariably rattles off five dots for every H, makes his Vs sound like STs, and his Ls and Fs so they might be almost anything.

Some of the erratic sending is the result of plain laziness or carelessness, but most poor key work can be blamed on the wholly erroneous idea that speed is the badge of the expert.

The beginner, finding that the sending which was good enough to get by on his amateur operator's license examination sounds slow compared with that of old timers on the air, immediately tries to speed up and pound the brass to the tune of twenty or twenty-five words a minute. Then trouble starts. His dots come in irregular bunches, his spacing goes to pieces, and his arm and wrist get tired and cramped.

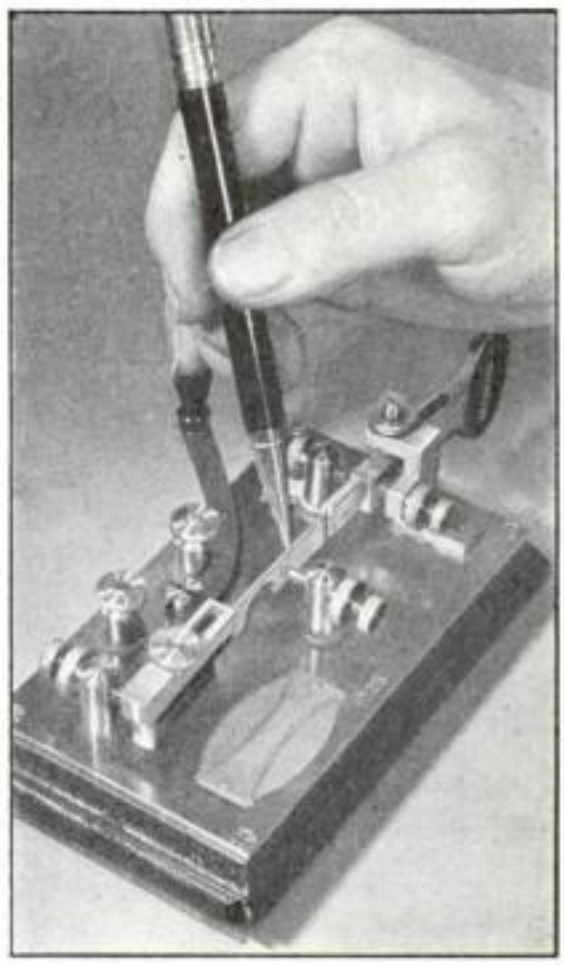
The next step is to blame the key and to experiment with other types such as the "side swiper" and the "bug." Unfortunately, this only makes matters worse unless he gets back to first principles and realizes that there is no substitute for laboriously developed manual skill. No matter what kind of a sending key you obtain, you must learn how to use it.

Although side swiper and bug keys are usually thought of in connection with fast sending, they are in fact excellent for slow and medium speeds. Once you learn how, you can send almost perfect code, the steady, medium speed kind that is so easily read, with either a side swiper or a bug. And your wrist will not get as tired as it does with the regular up-and-down motion, sending key.

The picture at upper left shows examples of the three common types of sending keys for radio or land line telegraphy. At the left is a plain key. Pressing down the button closes the contact. Releasing the button breaks contact. The middle key is a side swiper. Moving the lever either way from the center position makes contact. You can make a dot or a dash by moving the button sidewise in either direction.

A row of dots are made by wobbling the lever from one side to the other and as it obviously takes half as many motions to make a row of dots this way as it does to make the same number of dots with a regular key, the sideswiper permits twice the speed with the same amount of motion. What is still more important to the amateur is that it permits a reasonable speed with a relatively slow hand motion that does not tire the wrist of operator.

The key at the right is a bug. Several varieties are on the market, but they all work on the same principle. Pulling the vertical finger piece to the left with the index finger closes a contact to make a dash. Pushing the finger piece to the right with a brisk motion produces a string of dots in rapid succession. The speed with which the dots are made can be regulated by slightly moving a weight which is attached to the end of the spring.



Bug sender with pencil pointing to spring lever that vibrates to make dots at contact

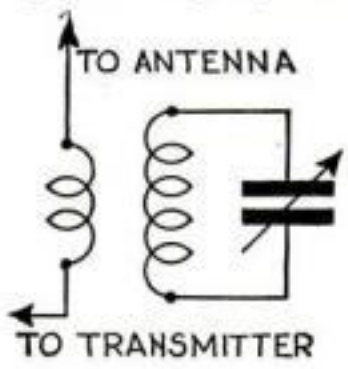
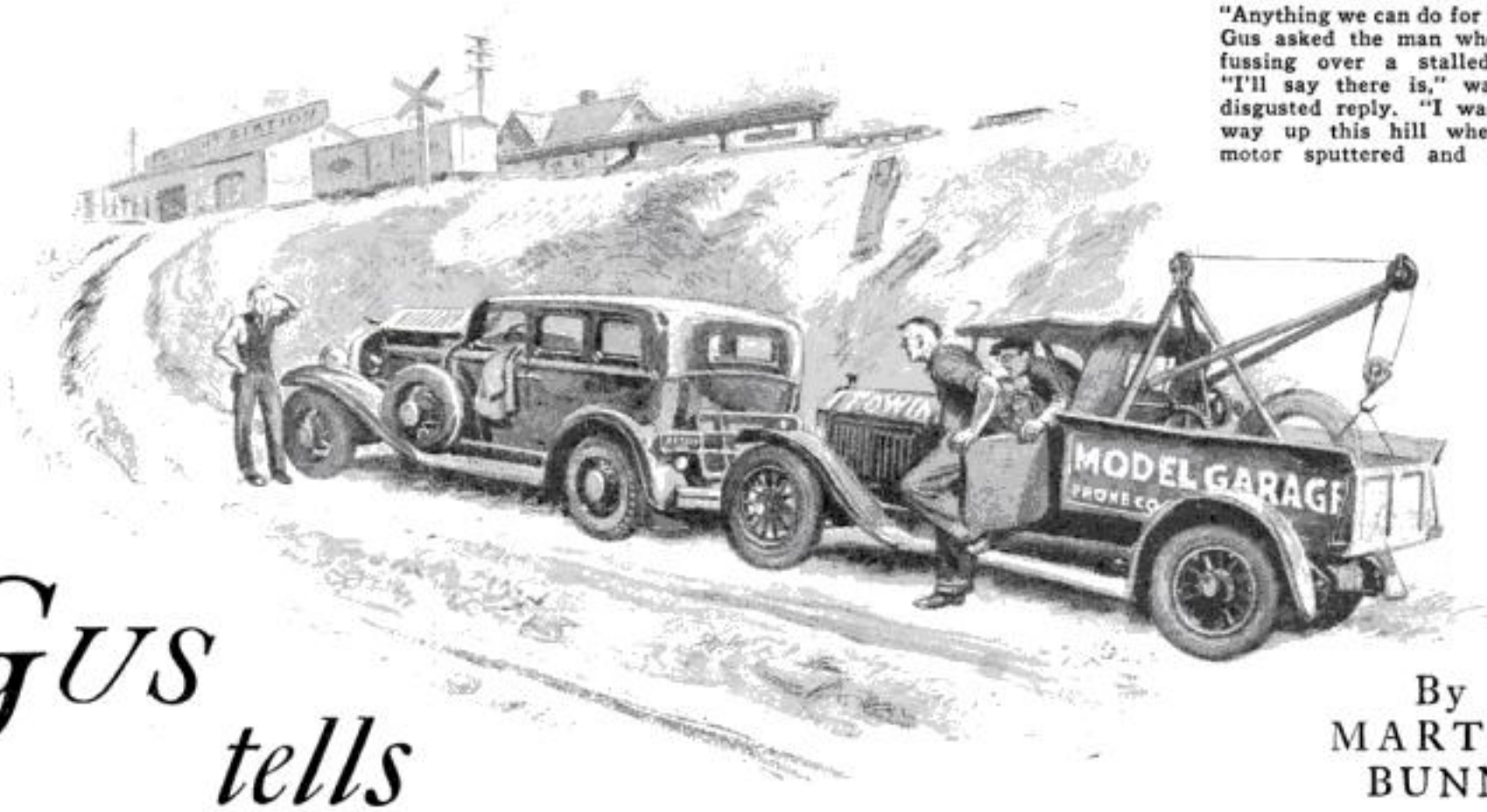


Diagram showing the way to trap out harmonics and get a single frequency transmitting wave on a single wire fed Hertz type antenna

Ousting Harmonics

MOST radio experimenters are familiar with the wave trap and the manner in which it is used to cut out unwanted stations. Many beginners at radio transmission do not know, however, that the same scheme can be applied to outgoing waves as well as to incoming ones. The Government requires that amateur transmission take place as nearly as practical on a single frequency.

Often the transmitter, even when carefully tuned according to the correct method, will radiate an appreciable amount of energy on a harmonic of the wave to which it is tuned. Push-pull type transmitters, such as the one recently described in this magazine, are not likely to radiate on even harmonics because the push-pull effect balances out that type of radiation. One or more wave traps can be used to suppress this radiation. A method applicable to the single wire fed Hertz type antenna is shown in the diagram at the bottom of the page. The trap coil need only be coupled to the antenna feed wire.



"Anything we can do for you?" Gus asked the man who was fussing over a stalled car. "I'll say there is," was the disgusted reply. "I was half way up this hill when the motor sputtered and died."

Gus tells How to Inspect a Stalled Motor

By MARTIN BUNN

GUS WILSON slid into the driver's seat of the wrecking car, touched the starter button, and was about to drive out of the Model Garage when Joe Clark, his partner, arrived for the day's work.

"Ride over to the freight station with me," Gus called in answer to Joe's greeting. "I've got to pick up a load of tires and I'll need some help. The kid will look after the place till we get back."

Near the station, the wrecker rounded a blind curve. Gus turned his head in response to a sudden nudge from Joe's elbow.

"Look," directed Joe, pointing to a small man standing beside the opened hood of a car parked half way up the steep hill directly ahead of them. "Somebody's got into trouble bright and early this morning. Scratching his head about it, too. Guess he doesn't know much about motors."

Gus took his foot off the gas and brought the wrecker to a stop a few feet behind the parked car.

"Anything we can do for you?" he inquired.

"I'll say there is," came the disgusted reply. "I was half way up this confounded hill when my fool motor began coughing and sneezing and finally sputtered and died. And I'll be hanged if I can find out what's wrong."

"Out of gas?" Gus asked as he stepped on the starter and pulled the choke all the way out.

"Nope. I thought of that, but the tank's almost two-thirds full."

"H'm. Plenty of gas and the gasoline line isn't plugged up either from the looks of this," Gus said, pointing to a steady trickle coming from the carburetor he had flooded by turning the motor over with choke out.

"Generally there are three things that'll make a motor die in action," Gus stated. "No gas, a clogged gas line, and bum ignition. Since it isn't the first two, your trouble probably is the ignition."

"But I had a new set of wires put in about three months ago," the man protested.

Gus grinned broadly. "The wiring's not the only thing that can go wrong with an ignition system. Ever hear of the breaker arm?" He unsnapped the clips on the distributor cap and pointed to a curved arm in the base of the distributor. "There's one place to look when a motor dies from bad sparking."

Interested, the driver leaned over the fender and peered into the distributor as Gus moved the breaker arm back and forth to illustrate its action.

"You see," Gus explained, "when the distributor shaft turns, the little cam attached to the shaft opens and closes these contacts. Now we'll turn on the ignition and see what happens."

Gus again opened and closed the breaker and this time grinned with satisfaction.

"There's the clue to your troubles," he reported. "The breaker points are so badly chewed up and burned they don't make good contact and they arc badly now and then just as they are opening.

"That means two things," Gus went on to explain. "First, the breaker points need redressing; second, your condenser's probably gone haywire. The burned points are what caused some of your trouble, but ten to one a bum condenser caused the contacts to burn in the first place. Been having any trouble with the motor lately?"

"Come to think of it, I have," admitted the man. "Had trouble starting only this morning, but after several trys I finally got it going and didn't think anything more about it. Maybe the condenser was on the blink then."

"Sounds like it," agreed Gus, selecting a screw driver and some small wrenches from the large tool box that formed a part of the wrecker's running board. "First we'll take out those breaker points and try and redress them. While we're doing that, Joe'll drive back to the garage and pick up a new condenser."

Gus was busily rubbing the contacts back and forth over a small oilstone when Joe Clark returned with the new part.

"As I was saying," repeated Gus after examining the condenser, "you can touch up these points without even taking them out if you want to. Just hold a small file between them and pull the file back and forth. That'll do the trick if they aren't chewed up too much. I always like to get them out in the open, though, where I can look them over."

With both garage men working, it wasn't many minutes before the points were back in the distributor, adjusted to the right spacing, and connected into the new condenser.

Gus laid his tools on the running board and slid into the *(Continued on page 93)*

Gus says:

When applying the brakes in wet weather, don't throw out the clutch until you've almost come to a stop; the motor will prevent the brakes from grabbing too quickly. Never apply the brakes suddenly and don't follow the car in front of you too closely. Be especially careful driving over wooden bridges or on wood block pavements.

A Matchless New Model for You to Build

The Battleship TEXAS

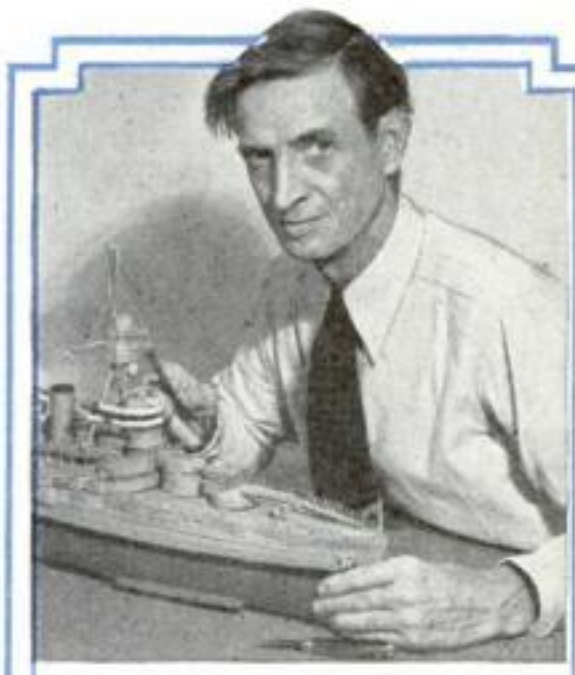
HERE is a model of one of the finest and most powerful battleships afloat—the U. S. S. *Texas*, flagship of the Atlantic fleet. It has been simplified to such a degree that anyone interested in model making can build it without difficulty and at relatively low cost for materials; and no special tools are needed.

This great modern battleship is ideal from the model maker's standpoint. Though beamy, she has fine lines. On deck there is a variety of parts of an unusual character—objects that are good looking in themselves—instead of a monotony of cabin structures and handrails such as are found on a passenger ship. She therefore makes a magnificent exhibition model. As a power-driven working model, she is equally desirable. Having a large displacement, the hull will carry with ease all the necessary machinery and is quite stable in the water.

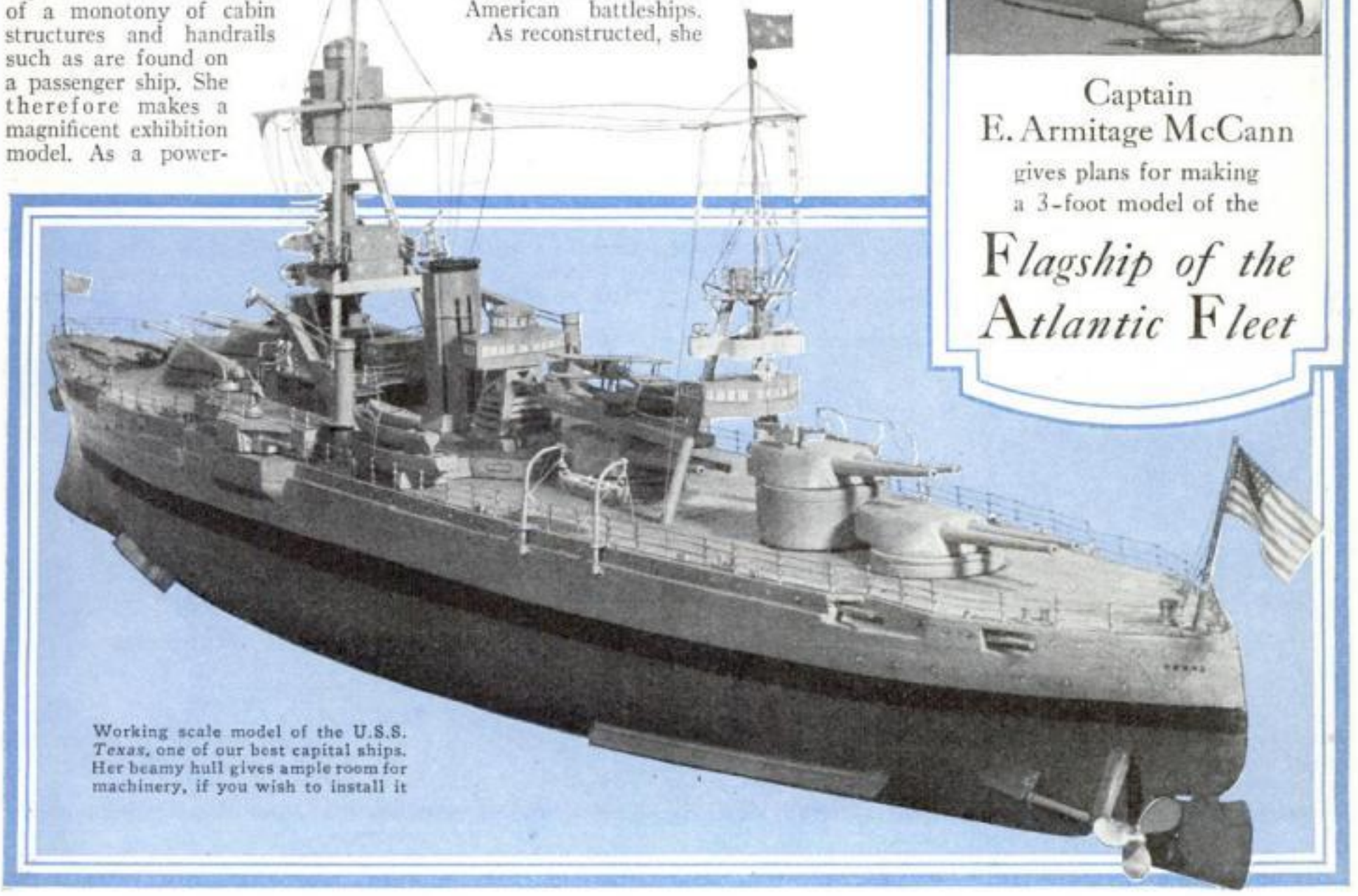
To those who have heretofore built only sailing ship models, I suggest that they try their hands at this battleship by way of a change as well as to learn the technic employed.

The *Texas* has been chosen because she has been modernized and now constitutes the last word in American capital ships, and also because she has tripod masts, which are better looking and easier to make than the "wastepaper basket" lattice masts of most of the American battleships.

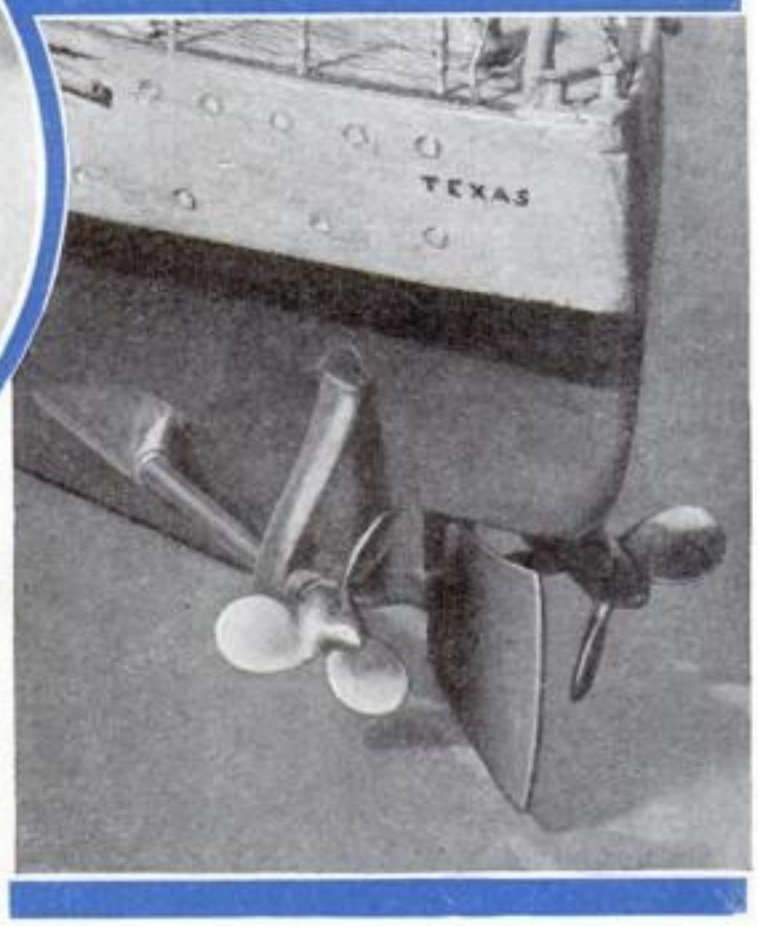
As reconstructed, she



Captain
E. Armitage McCann
gives plans for making
a 3-foot model of the
Flagship of the
Atlantic Fleet



Working scale model of the U.S.S. *Texas*, one of our best capital ships. Her beamy hull gives ample room for machinery, if you wish to install it



The model under way, plowing through a calm sea. Without anything to give away her size, she looks for all the world like her big sister. *Below:* A close-up of the stern showing the rudder and twin screws. Compare with the drawings on the next page

is so new and so important that the Navy Department will not furnish any plans, hence this model had to be worked out without official aid, but the lines and details may be taken as essentially correct. The bridge work is so complicated that it has been simplified to retain the correct effect, and many minor details, such as mushroom ventilators, have been omitted.

Though the model is specifically the *Texas*, it would serve almost as well for the U. S. S. *New York*. Both were built from the same plans, the former at Newport News and the latter at the New York Navy Yard. The differences are minor.

The *Texas* carries the ranking Admiral's flag and is so powerful that she could be miles out of sight of the coast yet blow a city to bits in short order. Her great 14-in. guns, 53 ft. long, will pierce armor plate so far away that it cannot be seen aboard. She has enough electric power to light a small city.

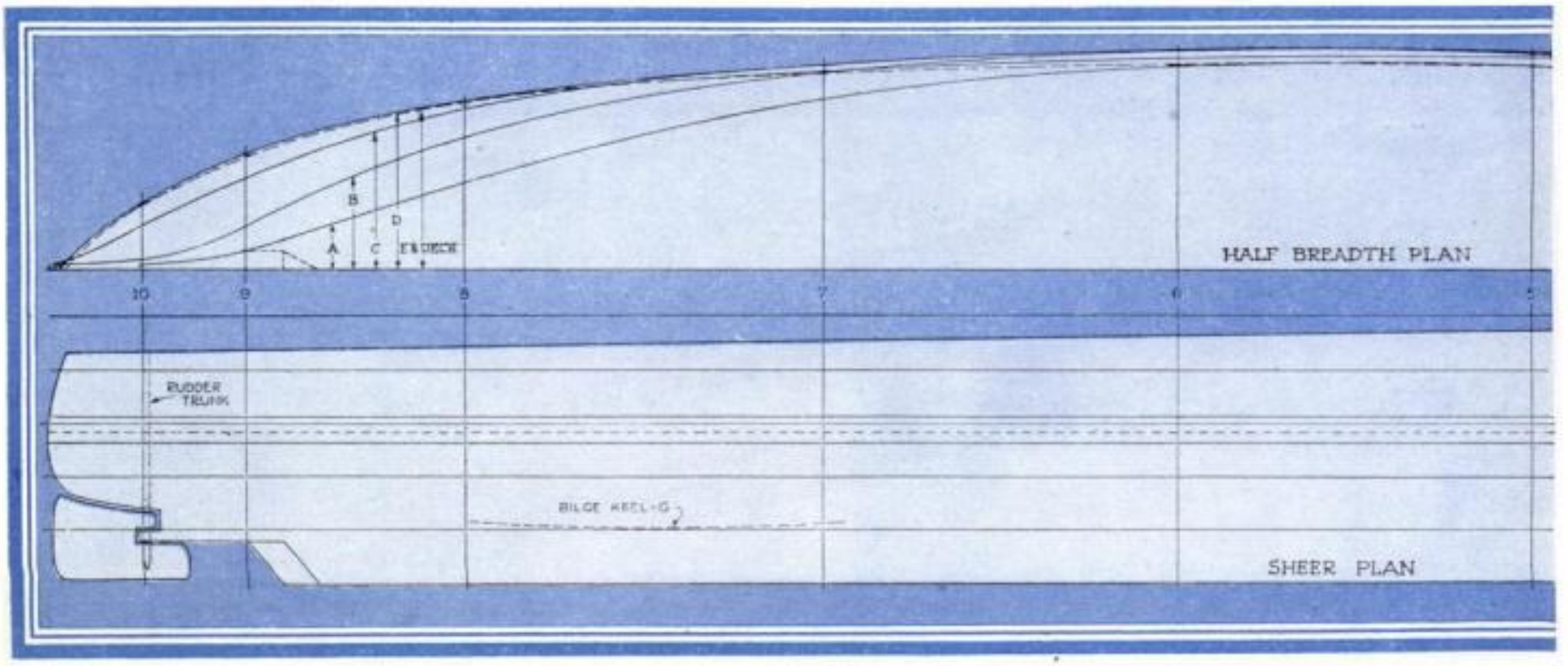
The real ship has a displacement tonnage of 27,000 tons and an allowance of 1,315 men, and she cost about $11,000,000. Her length on the water line is 565 ft., and the over-all length is 573 ft. The beam, without blisters, is 100 ft. On the scale of 1/16 in. equals 1 ft., this gives us a model almost 3 ft. long and 6¼ in. wide.

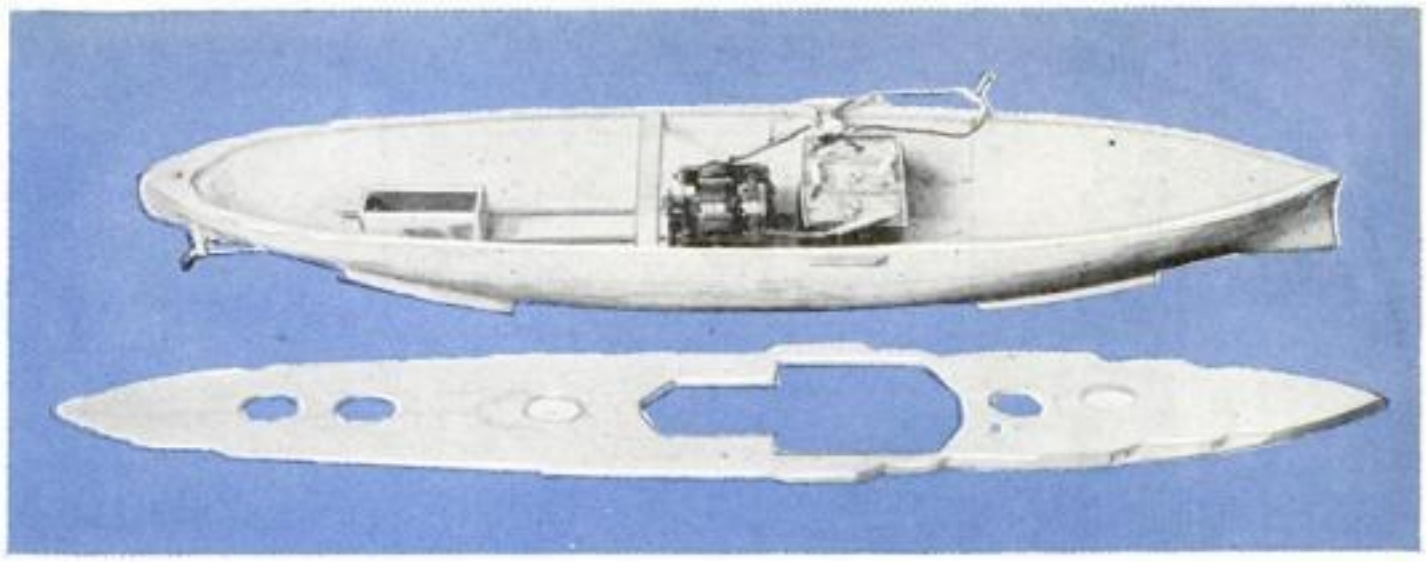
It will be seen on the sheer plan that the hull has been divided vertically into five water lines or lifts, each ¾ in. thick and 6¼ in. wide. On each piece of board (white or sugar pine or other soft wood) mark the corresponding outline from the half-breadth plan. This can be done by pinning the plan on the wood with two pieces of carbon tissue, back to back, between the wood and the paper, then cutting the plan down the center line and turning it over to get the other half. I prefer, however, to take off the lines on a piece of tracing paper and turn it over to get the other half. Draw the center line right round the board, as well as the construction lines Nos. *1* to *10*.

With a compass saw, jig saw, or band saw, cut the wood to these shapes. Then, as the model is to be hollow, jig-saw out the center of lifts *B*, *C*, and *D* to about ⅜ in. thick, leaving plenty at the ends. It is better also to leave in crossbars somewhere about the middle to prevent spreading until the hull has been glued up. Glue these lifts together, except the top lift, being careful that all the construction lines correspond. This is essential.

The top lift *E* must be planed down to ¼ in. thick at the stern. It is straight from end to end with no sheer, but a camber, or curve, of ⅛ in. from the edges to the midship line can be given. This, however, is a nuisance on a working model, so I left the surface flat. If you wish to add this camber, have it rise above the line shown on the drawings. Next mark on the wood the deck outline and draw the center and cross construction lines.

Screw this top lift temporarily in place and proceed to shave the sides of the hull to match cardboard or tin templates made from the lines of the body plan. It will be noted that the widths given on the half-breadth plan do not correspond throughout with the widths on the body plan at that position; that is, because the lifts have to be left wide enough to cut the extreme width, wherever it happens to come. Thus *D* is bigger amidships at the bottom





The hull with the power plant installed. The motor was taken from an old automobile horn, and the small but efficient storage battery is homemade

than the top, and *B* bigger at the top than the bottom.

These ships, as modernized, have in addition to the hull proper what are called "blisters"—vacant inclosed spaces built onto the hull below the water line as additional protection from torpedoes. They are about 4 ft. wide amidships, tapering from the water line to the turn of the bilge and from about line No. *3* to No. *8*. As they are ugly and not an integral part of the ship, they have been omitted.

Note that the stem is quite sharp until near the bottom where it has a "bulb" or roundness which flows into the body of the hull.

The body plan gives the shape the hull is first to be made. The upper part then has to be cut to represent the top edges of the armor plate and the casemates for the guns. The lowest cut-in is ¾ in. down from the deck, extends from line *3* to the bridge wing, and is 1/16 in. deep at the middle, tapering to the ends. Above that the three recesses for the casemates are cut ⅜ in. down. Aft there is a cut-in 5/16 in. down from the bridge wing to the foremost casemate, a full 1/16 in. deep.

Having shaped the outside, remove the deck piece and, if it is to be a working model, shave down the inside as thin as possible, but leave the bottom lift intact as a stiffener and platform for the machinery. Some of the waste wood from the deck pieces may well be cut away from underneath. If preferred, the entire hull can be hollowed out and a thin deck laid.

Cut away the cross struts and put in a deck beam at each end of the opening.

The next thing to do is to install the power, if you intend to make a working model rather than merely a scale model for exhibition purposes. As there is plenty of room, any type of drive can be used—clockwork, steam, or electric. The average model makes will find the last to be the most satisfactory. I was advised by Mark A. Cooper, of Rome, Ga., who gave me some valuable suggestions, to try a motor from an automobile horn, and got one for a few cents. This works quite well, but I think a high-grade motor made for the purpose would be even better.

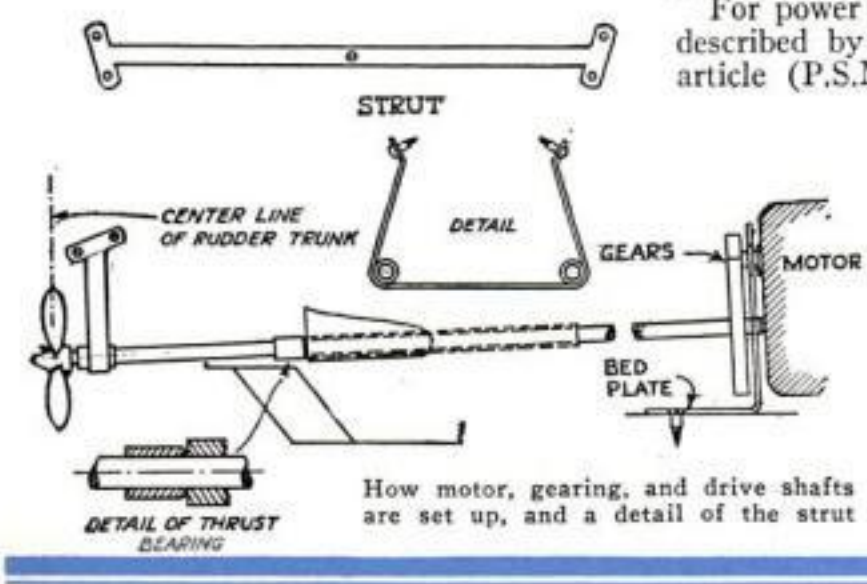
For power I built a storage battery as described by Mr. Cooper in a previous article (P.S.M., June '31, p. 108). This was made from standard size battery plates sawed in four, with two positive and three negative plates in each of the three cells. It is 3½ by 3 by 2¾ in. high, weighs 3 lb., and drives the motor under full load for about an hour.

The motor, of whatever type, must be fastened to a plate of stiff metal, the bottom of which is turned up and drilled so that it can be screwed to the bottom of the vessel to form a stand. If the motor is at all heavy, it should also have a leg fastened to the back end. Through this plate a hole is drilled through which the motor shaft may project. To find the height of this shaft it will first be necessary to adjust the propeller shafts.

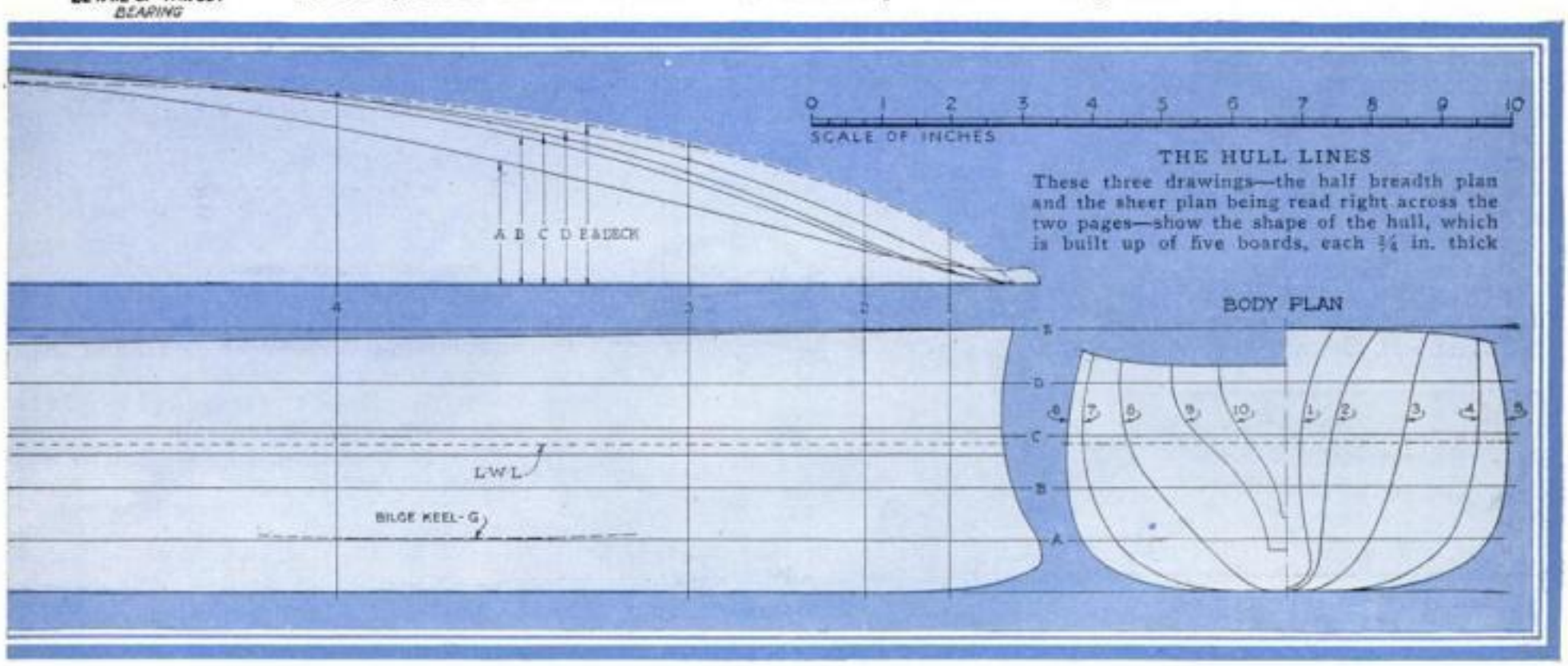
The vessel has twin screws or propellers of about 1⅛ in. diameter. The shafts are ⅛ in. brass rod about 16 in. long. For the shaft tubes, two pieces of brass tubing about 4 in. long and of a diameter to fit easily on the shafts are required. First cut the double strut to the shape shown; that is, to screw to the raised part of the keel, extend horizontally ⅞ in., then turn upward to screw to the hull about 1⅛ in. up, ending in cross flanges for that purpose. Cut a 5/16-in. piece off the tube and solder it into the bend of the strut for a bearing. Put the propeller on the shaft, reeve the shaft through this bearing, and temporarily fasten the strut so that the center of the blades will be in line with the line of the rudder post, previously marked.

Before you can do this, holes will have to be drilled in the hull through which to pass the shafts. It is best to make the holes amply large and then, when the tubes are finally in position, to wedge them and fill in with plastic material. Cut another ¼ in. off each tube, reeve them on the shafts, then place the remainder of the tubes and reeve them through the hull.

In the next article the installation of the motor will be described, and we shall begin to add the details to the hull.



How motor, gearing, and drive shafts are set up, and a detail of the strut

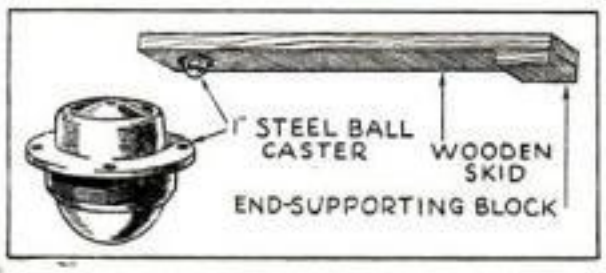


THE HULL LINES

These three drawings—the half breadth plan and the sheer plan being read right across the two pages—show the shape of the hull, which is built up of five boards, each ¾ in. thick

SMALL MACHINE ROLLS ON TWO CASTERS

Moving a small motor-driven saw



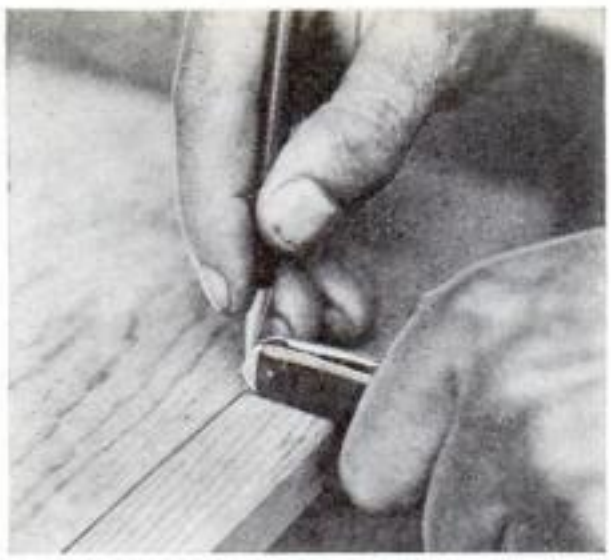
With this type of skid, a small home workshop machine will not shift while it is being used

SMALL home workshop machines with individual motor drives may be made more readily portable by the method illustrated. This requires only two casters for each stand and, indeed, is better than using four casters because there is less tendency for the machine to roll or shift while it is being used.

Steel ball casters are usually better than wheel casters for this purpose, especially on a cement floor. To equip a machine with this type of caster, make two wooden skids as shown and bore a hole near one end of each skid to insert the caster. If a bit is used which will allow the casters to fit snugly, no fastening will be required. Then attach the skids to the stand.

Equipped in this way, the saw table shown and similar machines can be moved about merely by inserting a strong wooden bar through the openings in the upper part of the stand and lifting one end from the floor. The illustration also shows a cover for the motor. It is essential to leave this open on the end opposite the pulley to allow for a circulation of air through the motor. The cover may be removed by first unloosening the pulley, which takes only a minute.—JOSEPH J. LUKOWITZ.

HALF aviation gasoline and half naphtha is a good mixture for cigarette lighters. The naphtha assures a quick light, and the gasoline retards the evaporation of the more expensive fuel.—K. M.



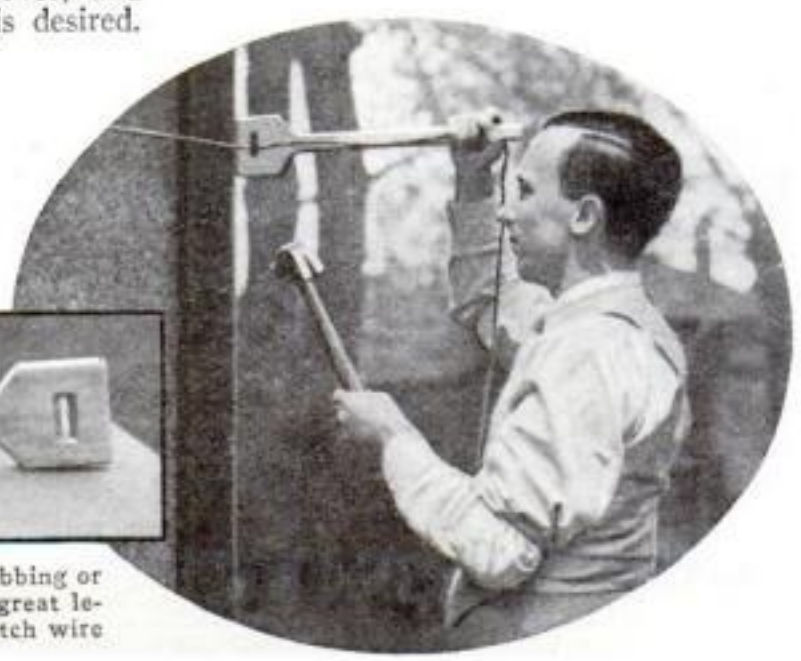
POCKETKNIFE DOES DUTY AS MARKING GAGE

ORDINARY saw-and-hammer repair jobs often require more tools than we take along, and one of these is likely to be a marking gage. In a pinch, a pocketknife makes an excellent substitute. The point of the pencil—or of a nail used as an emergency scriber—rests snugly in one of the blade hinge grooves, while the body of the knife is held as shown. The line is marked at the desired distance from the edge by sliding the thumb nail along the material, the pencil being held in place with the other hand. A carpenter will often gage a line merely by holding his rule in the same manner as the knife and keeping his pencil against the end of the rule, but that is more difficult.—F.W.B.

WOODEN TOOL STRETCHES WEBBING AND WIRE

FOR most upholstery work it is necessary to use a webbing stretcher. The one illustrated below, which is a copy of a tool more than 75 years old, is easy to use and gives such great leverage that the webbing can be drawn as tight as a drum. It is made from a piece of 1-in. hardwood 15 in. long. A hole ¼ in. wide and 3 in. long is cut through the center of the thick part, and the edges are sloped back for ½ in. A triangular locking piece is then made that fits loosely into this notch on either side. One edge of the webbing is tacked securely on the frame. The webbing is then doubled, the doubled portion is passed through the hole, and the triangular piece inserted in the fold. The stretcher is held vertical and close to the frame, then pulled with one hand towards the operator. The tacking is done with the other hand, and the webbing is cut off, bent over, and nailed again if extra strength is desired.

This tool is also very useful in stringing wire. One of the photographs shows a piece of clothesline wire being stretched tightly along a garage wall as a support for a row of sweet pea vines.—H. CALDWELL.



A homemade stretcher in which webbing or wire is held by a wedge. It gives great leverage. *At right:* Using it to stretch wire

A CHESS SET FOR INTERRUPTED GAMES

IN THE manufacturing plant where I am employed there are chess players all over the building, but the actual time they can devote to a game is fifteen minutes each day. To provide an inexpensive type of board so that a game can be continued from day to day without the pieces becoming disarranged, I designed the outfit illustrated. Balsa wood such as is used in model airplanes provides the material for making the strips which divide the board into squares and also the blocks which represent the chessmen. The various blocks are identified by sticking on them paper symbols cut out from the chess problems published in a Sunday newspaper.

This little chess set, which is better than many commercial designs, costs but a trifle to make

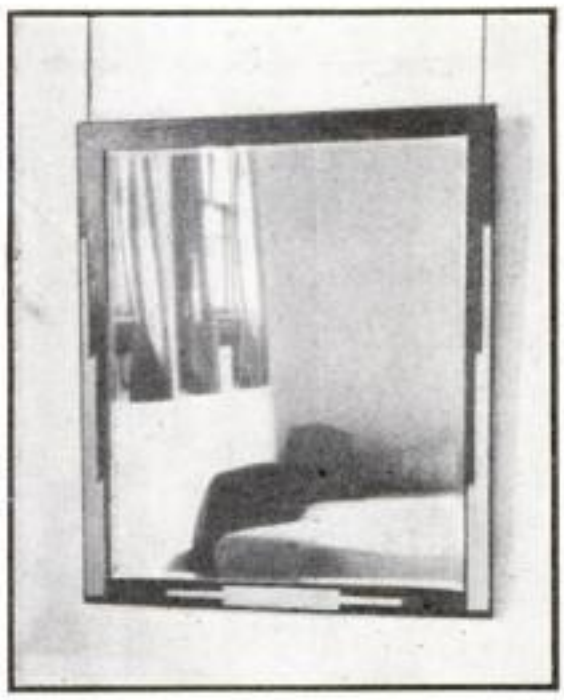
Each of us has two or three of these boards and we keep correspondence games going on with men or women on other floors, besides a daily game with somebody on our own floor.—A. M. SMYTH.

TEMPORARY ADHESIVE LEAVES NO TRACE

A USEFUL adhesive wax for temporary purposes can be prepared by adding a teaspoonful of Canada balsam to one ounce of melted beeswax. Stir together, pour into a shallow flat tray, and, just before the wax hardens, cut it into inch square blocks. The wax is used by pinching a small lump off the block and working it in the fingers till it gets soft. The softened wax is then placed between the two surfaces which are intended to adhere and they are pressed firmly together. In this way objects weighing up to a pound may be stuck to a glass window for display. The wax will strip off without leaving a trace.—DOUGLAS LEECHMAN.

Modern Mirror Made from an Old Golden Oak Cast-Off

The mirror above, which was taken from a clumsy old golden oak dresser, was easily transformed into the expensive looking one shown at the right



THERE is no end to what can be done in modernizing old furniture. Every attic will yield pieces that can be magically transformed. The mirror from a discarded golden oak dresser, for example, can be converted easily into a piece that is as up-to-date and smart looking as anything you can buy in a furniture store.

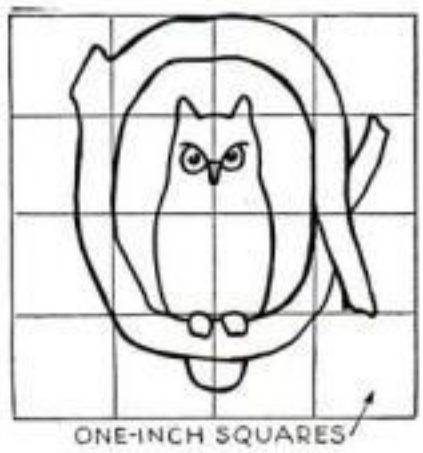
If you have such a dresser in the attic or can obtain one for a song, as is often possible, take off the mirror, sandpaper the frame, and then prepare trimming pieces to ornament the sidepieces and bottom as shown in the second of the accompanying illustrations. These strips are ½ in. square, the longest one on each side being about three quarters the length of the mirror frame. The ends of the strips are given a finished appearance by beveling them off at an angle of 45 deg. Before fastening on the trimming pieces with glue and fine brads, remove the glass from the frame so there will be no danger of breaking it.

Give the old woodwork two coats of black brushing lacquer and the ornamental strips one coat of shellac and one of gold bronze, or use any color scheme suitable to the room in which the mirror is to be hung. Screw two eyes in the back of the frame and hang the mirror with heavy silk cord. I used a black cord about ⅛ in. in diameter with a wire running through it, which I obtained at a ten-cent store. Small triangular pieces of wood painted either black or gold are fastened to loops at the upper ends of the cords to hide the hooks from which the two black cords are supported.—CHARLES H. ALDER.

NOVEL JIG-SAWED WINDOW SHADE PULLS

THIS ornamental little pull for a window shade is made in the form of an owl sitting on a curved branch. To prepare the pattern, divide a 4-in. square into 1-in. squares; then draw the lines of the pattern from point to point across the squares as shown in the small diagram appearing below.

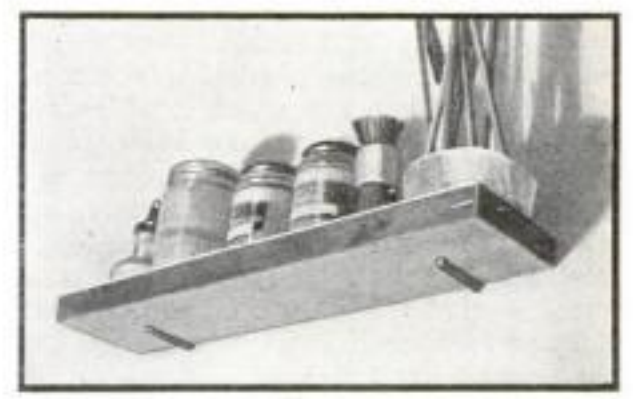
The wood used should be thin but not brittle. Thin plywood such as is sold for making jig-saw puzzles is especially good. Transfer the lines of the pattern to the wood, cut out the shape, and trim away the space around the owl and inside the curved branch.



A new use for your jig saw—making ornamental shade pulls

Enamel or lacquer the branch very dark brown on both sides, and the owl a medium shade of brown. Of course, the branch will not show across the back of the owl, so carry the medium brown right down to form an unbroken area the shape of the owl's back.

Make the owl's eyes yellow with black centers, and its feet a shade lighter brown than its body. Decorative pulls are usually made in sets.—HAZEL F. SHOWALTER.



LONG HOOKS FORM NEAT SHELF BRACKETS

LARGE square screw hooks of the type shown make neat brackets for narrow shelves and may be moved easily should occasion demand. The hooks are placed about 3 in. from either end of the shelf and extend out from the wall about 2 in. for a shelf 3 in. wide. This width is sufficient for small cans of paint, spools of wire, and similar home workshop supplies. Two holes are drilled in the underside of the shelf to receive the ends of the hooks. The position of these holes is marked directly from the hooks by setting the shelf in position and rapping it sharply with a hammer.—DANIEL REYNOLDS.

IMITATION PLATING FOR BRASS AND COPPER

MANY an amateur radio operator wishes his coils were a shiny silver instead of dull copper. Here is a process that can be applied right on the spot: Place 2 oz. of nitric acid in a 4-oz. bottle and add about ½ oz. of mercury. When the mercury has gone into solution, add enough water to fill the bottle. Apply this solution to the coils—or, for that matter, to any brass or copper surface—and rub it in well with a rag or stiff brush. Then polish with a dry, absorbent cloth and go over the surface with a colorless lacquer. Unless the lacquer is applied, the surface will not remain bright.—WALLACE H. MCCLAY.

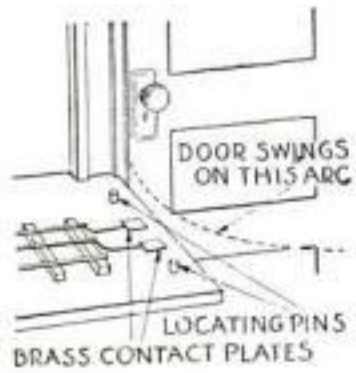
MODEL TRAINS

Pass Doorway on Bridge

Five exceptionally useful kinks for those who operate miniature railways

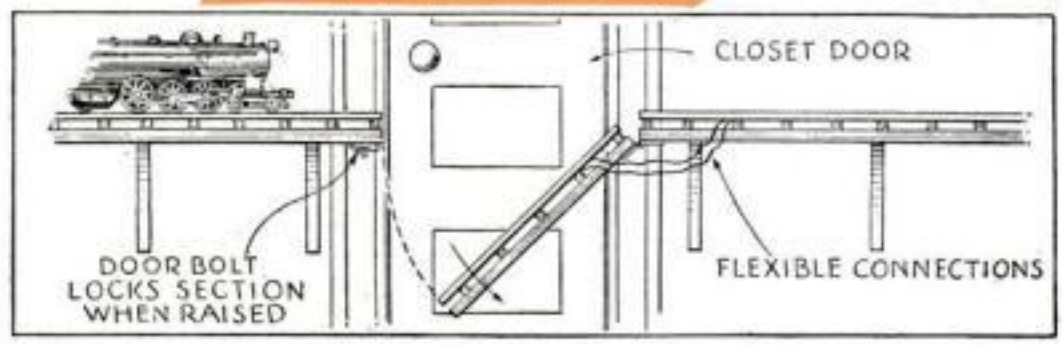
IT OFTEN happens that the room in which a model railway system is to be located has a door that opens inward. This makes a continuous track circuit an impossibility if the installation is to be mounted permanently on a shelf around the wall, because the door interrupts the circuit. A solution of this problem is shown at the right. The shelving is carried to the door jamb on both sides, and then a trestlework bridge is built to join the open ends when the door is closed. By means of spring contacts and tiny locating pins, the bridge can be lifted out and replaced without disconnecting any wires.

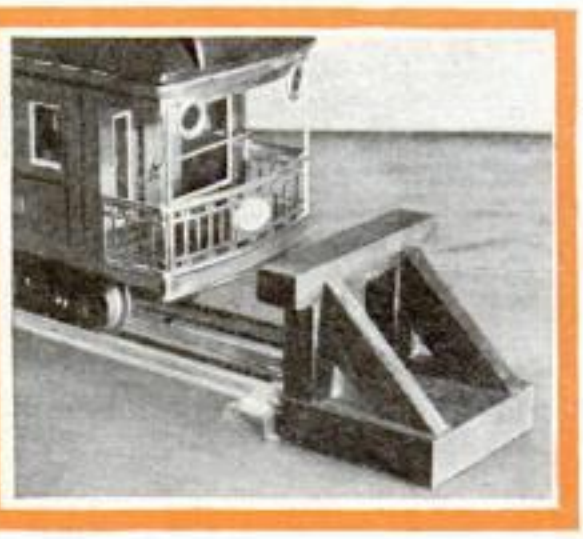
In cases where a bridge of the type shown is not desired, another scheme is to fit a hinged section which can be swung up into place when the door is closed and swung down out of the way when it is necessary to go in or out. Flexible leads can be carried to the track on the hinged section. It is possible to fit the movable piece so that it swings up, but it is much simpler to have it swing downward.



Removable bridge section allows the door to be opened

Above: Diagram showing how the locking pins and brass plates are arranged. *Right:* Second method, using hinged section that swings down





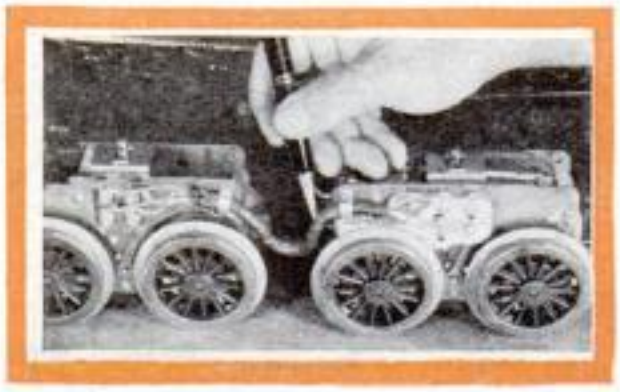
Bumper Gives When Hit

A WOODEN bumper for model railway sidings is illustrated in the photograph above. It is easily made of the lumber from an old crate. The size should, of course, be in proportion to the scale of the track.

In cases where the end of the siding is so located that a train running off the end will come to grief by falling off the table, the wood parts of the bumper should be solidly screwed and glued together. If, however, no harm will come to the cars or locomotive if they go off the end of the siding, it is an advantage to put the bumper together with light brads so that it will be strong enough to hold against ordinary jars, but will let go if struck hard by a runaway train and thus not bend the couplings or put dents in the ends of the rolling stock.

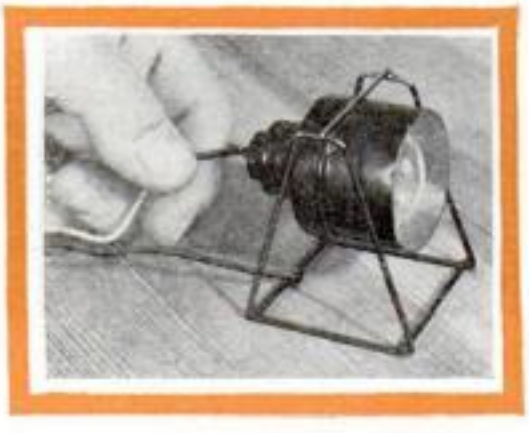
Adding Weight to Cars

TO ADD weight to some of the units of your model railway is often desirable. A locomotive, for example, will pull a much heavier load and run with more realism if it is loaded to give the wheels better traction. Again, you may want to equalize the speed of two different trains. Additional weight applied to the faster train will do the trick. The simplest way to add weight is to bolt flat lead plates underneath the body as shown at the right. This keeps the weight low as well as out of sight. Strips of strap iron will do if lead is not available. Drill through the floor of the body and the extra piece, and fasten with one screw.



Cables for Locomotives

ORDINARY stranded wire is not suitable for the electrical connections between the two motors of a double motor driven model railway locomotive. An exceptionally flexible wire for this purpose is the so-called "litz" wire used for winding high-frequency radio coils. The photograph above shows a connecting cable joining twin motors that is made of "litz." The group of four wires is armored with a sheathing of tire tape torn into narrow strips.



A Simply Made Flood Light

FROM an empty round talcum powder can, an automobile type single-contact socket, and some radio bus wire can be made the little flood light shown at the left. The lower portion of the talcum powder can is cut off and the cap removed so that the socket can be soldered into place. The framework is made from bus wire, and the whole is given a coat of black paint on the outside. This unit is useful to flood light a station or some special scenic effect.

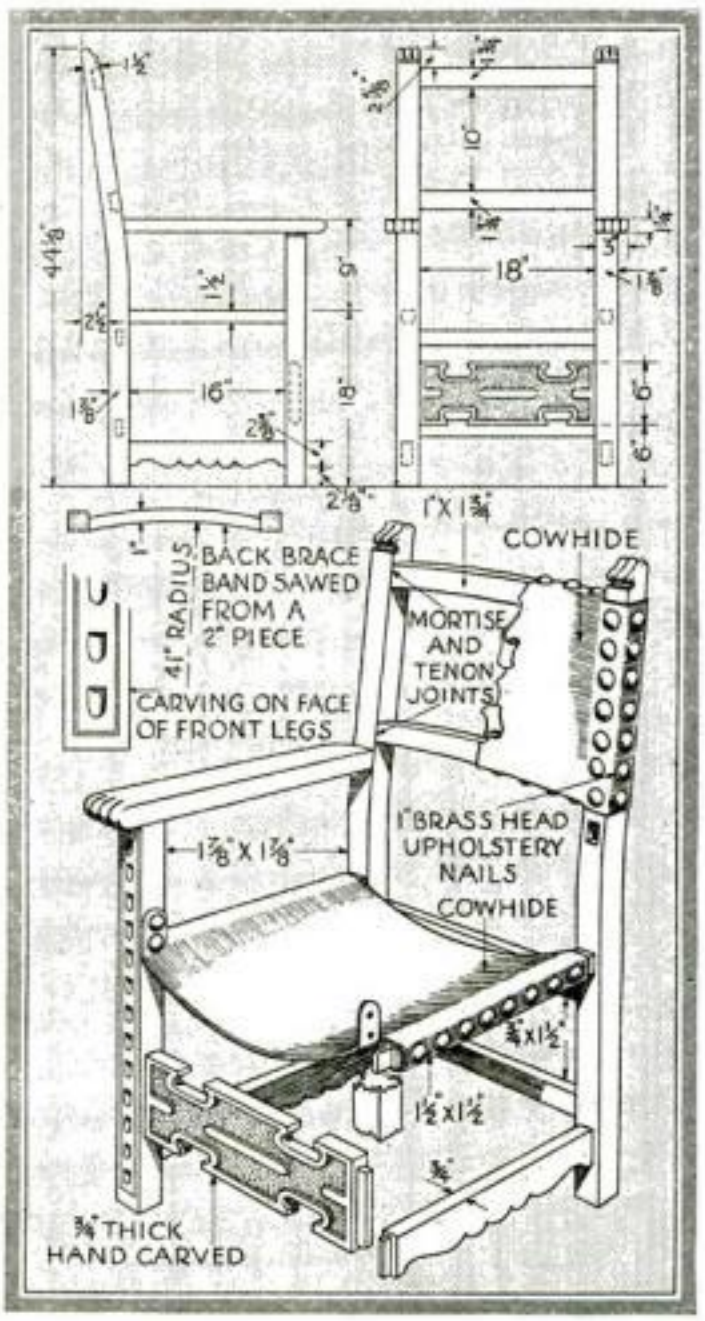
Comfortable . . . Beautiful . . . Easy to Build

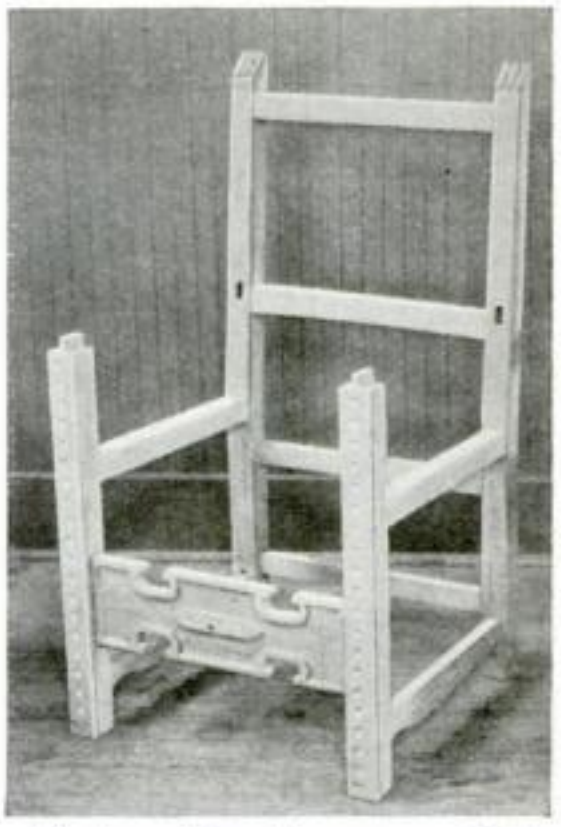
An ARMCHAIR

OF MAHOGANY AND COWHIDE

By Hi Sibley

A chair designed in the early Spanish mission style. The drawings are given at the right





The frame before the arms are added. All joints must be strongly mortised

REAL comfort is combined with simplicity of construction in this fine example of an old Spanish armchair. It is a design handed down by the old *padres* of California who were obliged to do the best they could with the simple tools and materials at hand and who succeeded in creating a distinctive style that has been popular for many generations.

Making the chair will prove a comparatively easy task for the home woodworker, provided he does not mind attempting a little simple woodcarving and has access to a band saw large enough to cut the curved cross members and uprights for the back frame. If necessary, of course, those members can be sawed out at a woodworking mill or at any well-equipped carpenter's shop.

The chairs shown in the photograph were built by B. D. Harrison's woodworking class at the John Muir Technical School, Pasadena, Calif. They are constructed throughout of Mexican mahogany of the variety known as Tabasco, and the best grade of cowhide was used for the seat and back. The materials cost in California about $10 for each chair. By using less expensive wood and leather, one could, of course, cut down this outlay.

Note that the front legs are straight and 1⅞ in. square in section. The rear legs have the same section at the bottom, but at a point 18 in. from the floor they start to incline backwards and from this point they also taper to 1½ in. thick, although retaining the same width—1⅞ in. For cutting out the rear legs with their 2½-in. backward slant, a piece 4½ in. wide will be required. The curved back braces are cut from a 2 in. thick piece on a 41-in. radius, leaving them, when complete, only 1 in. thick.

The leather seat is supported on 1½ in. square pieces. All cross members are joined with well-glued mortise and tenon joints. Take pains to have the joints fit snugly. A fine chair of this class deserves your best workmanship, and its durability depends largely upon the way the joints are made and glued.

The carving, which should be done as indicated in the drawings, will not tax the amateur's skill, as any irregularities merely enhance the rugged handmade look.

Sandpaper all parts, except the carved work, to a velvety smoothness, and if the chair is made of Tabasco or Philippine mahogany, moisten the wood with water to cause the grain to swell, and sandpaper again. Then stain the wood, apply paste wood filler, and finish with three coats of shellac. Sandpaper lightly after the stain and filler coats, but use very fine steel wool to rub down the first two coats of shellac. Steel wool of the No. 3/0 grade is suitable, if it can be obtained. The last coat of shellac is left untouched.

HOW TO WHITTLE A PEACH-PIT MONKEY

WHITTLING peach pits is a favorite schoolboy pastime, but it is rare that so skillful an example is available to copy as that shown at the right. It was made by Edward A. Ringhoff, of Denver, Colo., with a pocketknife, and ordinary nail file, and a small piece of steel wire like an old-fashioned knitting needle. It is best to use a peach kernel that has aged about four months. The smooth edge forms the back of the monkey, and the blunt stem end the head. It is important to select a pit that has its natural grooves properly spaced at the upper end for the ears.—RUBY D. WATSON.

Amusing monkey charm carved from a peach pit

Paneling Walls *with* Paint

AND OTHER SHIPSHAPE HOME HINTS •

INTERIOR walls that are decorated with a flat paint in a solid color often can be improved greatly by the addition of striping lines in a darker shade. These are arranged to give the effect of panels. Although many painters use an ordinary beveled straightedge to guide the striping brush, amateurs will obtain equally good results, with less chance of smearing the stripe, if they guide the brush with the fingers in the manner illustrated. Since in many cases the striping is to follow wood trim and outline doors and windows, the trim itself can often be used in place of the straightedge. Although a single wide stripe is sometimes used in paneling, better effects can be obtained with two parallel stripes, one wide and one narrow. The stripes usually should be placed 3 or 4 in. from the trim and ceiling line, and the widths vary according to the size of the room. The wider the stripes, the farther they should be from the trim.—M. W.

When plain, flat wall paint is used to decorate a room, the bareness of the walls can be relieved and given a touch of distinction by adding stripes in a somewhat darker shade to form panels

Four Important Jobs for November

Take down all screens.

Rake and burn leaves.

Clean outside drains.

Turn off water supply to outside fixtures that are likely to freeze.

Acid Cleans Water Gage

BEFORE starting up the heating plant for the winter, the home owner will do well to inspect the insulating covering. If the asbestos has become cracked or loosened, it can be repaired with asbestos cement, which is obtainable at most hardware and plumbing supply shops. If the glass water-level gage on the boiler has become so covered with rust that it is impossible to see the water, it can be cleaned in the following way: Build up at least 3 lb. of steam pressure in the boiler. Close both water gage valves; then open first the bottom petcock and next the top valve. As soon as the steam rushes out through the petcock, close the top valve and immerse the open petcock in a solution made up of one cup of hot water and one teaspoonful muriatic acid. Turn the steam on until it bubbles through the solution, then turn it off, creating a partial vacuum and causing the solution to be sucked up into the tube. Repeat this as often as necessary to clean the glass; then close the petcock, open both valves, and the job is done.—F.Y.

Cleaning water gage with muriatic acid

How to Stop Small Boiler Leaks

SMALL leaks in a steam boiler should be repaired at once, but this does not necessarily require the service of a plumber. It frequently can be done by adding a mixture of bran and corn meal to the boiler water. To make the repair, the water in the boiler should be warm. First remove the safety valve and, after making sure that the water level is within about 2 in. of the valve opening, pour in a mixture of 1 qt. bran and 1 pt. fine corn meal.

Replace the safety valve and build up the fire. After the water has been boiling for at least forty minutes, allow the fire to die down and carefully remove the safety valve. Next drain a bucket of water from the drain faucet and pour it into the valve opening. When the valve has again been replaced, rebuild the fire to the boiling point. It is best to repeat this cycle of operations at least three times.—K. E.

Quick Way to Defrost Refrigerator Coils

APARTMENT house dwellers having mechanical refrigerators served by a central compressor unit in the basement need not wait for the general monthly defrosting of the entire system to remove the frost from the refrigerating coils in their own cabinet. An electric fan placed back of an electric toaster or a hair drier of the type having heating coils can easily be arranged so as to blow hot air on the coils and melt the frost. This usually takes from ten to fifteen minutes. It is best to remove the more perishable foods during the operation.—WILLIAM C. REICHARD.

Defrosting a refrigerator with fan and electric toaster

Damp Resisting Kalsomine

A DAMPPROOF or water resisting kalsomine or whitewash can easily be made by adding about ½ lb. of waterproof casein glue to every 16-qt. pail of the finish. Mix the glue powder with equal parts of water by volume and, when it is dissolved, stir the resulting liquid into the kalsomine until thoroughly mixed.—B. D.

Nov 1932

• YOU CAN AMAZE YOUR FRIENDS WITH THESE

New Fan Whittling Stunts

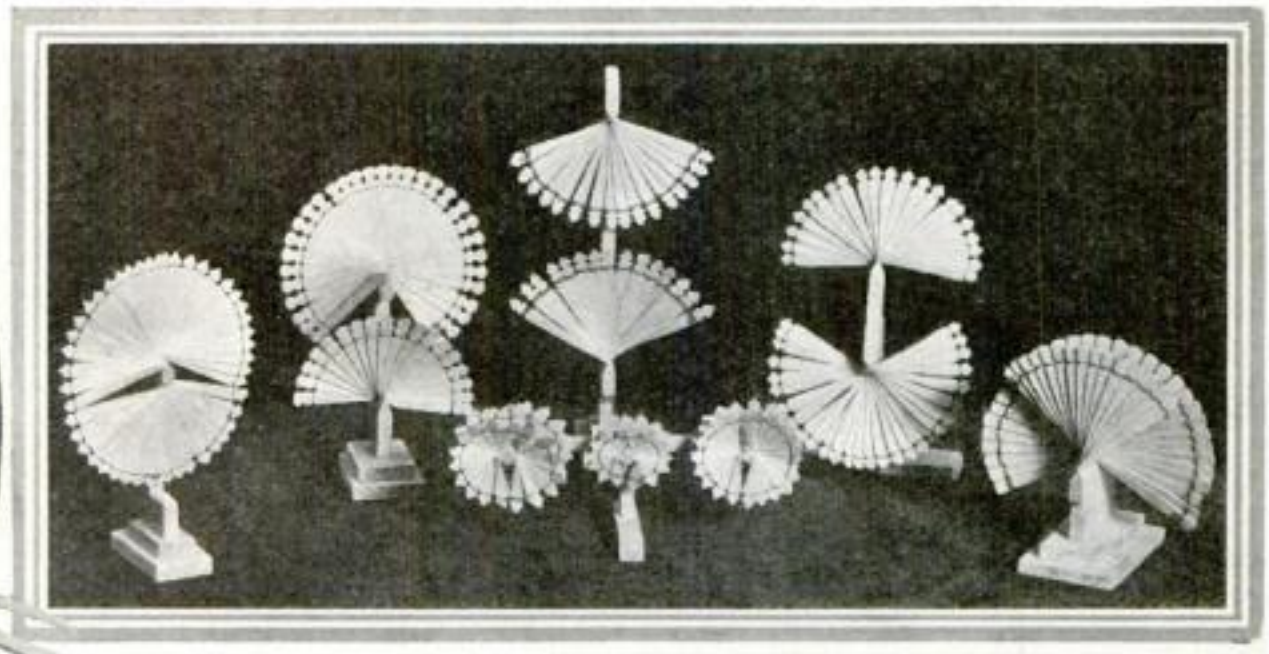


Fig. 1. A figure carved from one block of wood and a variety of fans. The lower one in the center is made up of ten circular fans, four in the middle and three on each side

By E. J. Tangerman

WHITTLING ornate fans from a single block of wood is a favorite stunt. It looks difficult but is really a comparative simple matter. Few whittlers realize, however, that the same method can be adapted in ways never before used and that such miraculous looking feats can be accomplished as carving the figure of a woman in a billowing skirt, or making a bird with outspread wings and tail in a cage—all from one piece of wood.

The first requirement for any type of fan is a piece of fairly soft straight-grained wood such as white pine or basswood. Thickness does not particularly matter, except that it does, of course, affect the blade width and consequently the width of the entire fan. Any width between ¼ and ¾ in. will do. In the drawings *A*, *B*, *C*, and *D* of Fig. 2 are illustrated the fundamental steps in making a simple fan. A block such as *A* is notched as at *B* to provide a thin part upon which the individual blades can be pivoted. The blades are produced later by splitting the piece and spreading the sections apart. Some sort of end design, such as that on the block at *B* or the more complicated design at *E*, should be put on the end of the blades before they are split apart. All sorts of elaborate shapes may be cut, and holes may be drilled through to form a tracery or scrollwork.

When the finished blade shape has been produced, the block is soaked in water for from twelve to twenty-four hours. It is then removed and the leaves or blades are split apart as at *B*, care being taken that no section of the split goes beyond the bottom of the double notch. This is where the grain in the piece plays such an important part—it must run straight.

As soon as the blades are split and while the block is still very wet, it is grasped by the butt or base and by the tops of the blades so that the blades are held tightly together. The butt is then twisted one quarter turn. This begins the separation of the leaves, as at *C*, and they can then be spread individually as at *D*. At their tips the blades may be locked or interlocked as shown, or they may be held separate by passing a doubled cord under and over and knotting it between each blade.

This procedure results in fans of the type shown in Fig. 1. One of them, the triple fan at the bottom of the photograph in the center, consists of ten complete circular fans all made on the one piece, four in the middle and three at each side.

The first step in its wider application is to make a *(Continued on page 99)*

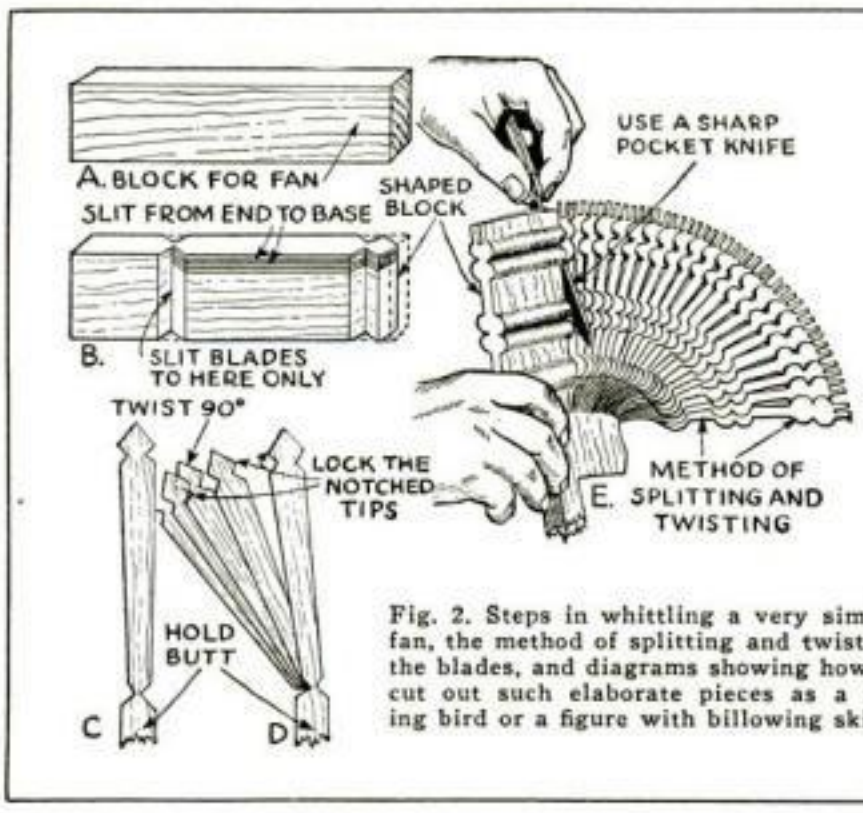
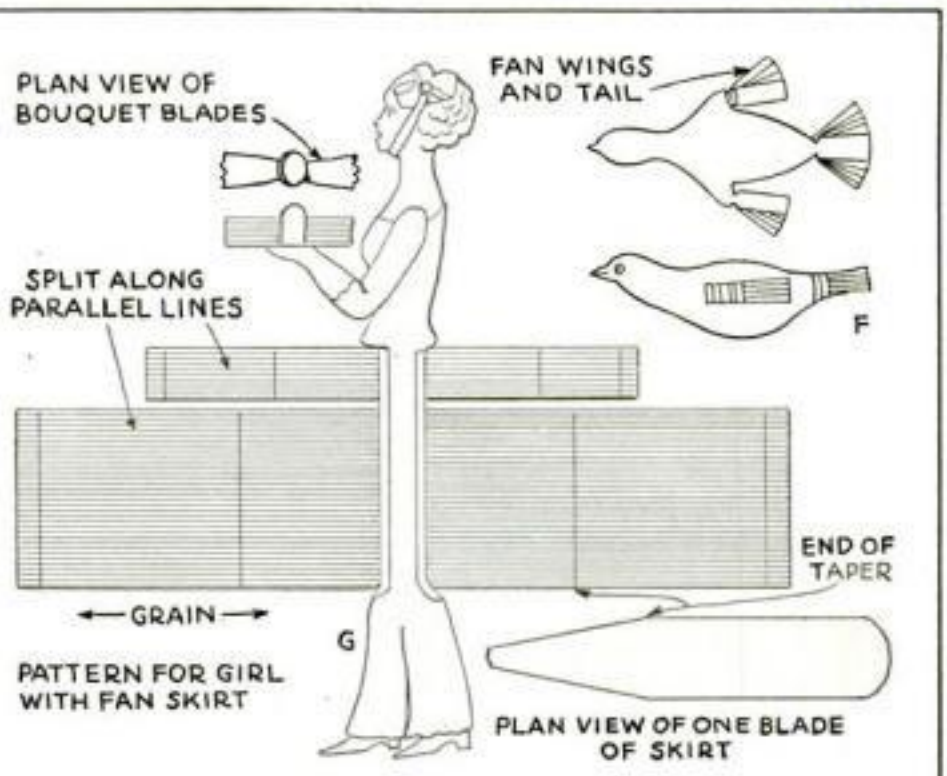


Fig. 2. Steps in whittling a very simple fan, the method of splitting and twisting the blades, and diagrams showing how to cut out such elaborate pieces as a flying bird or a figure with billowing skirts



Realistic Seaplane Model

REQUIRES ONLY TWENTY-FIVE SIMPLE PARTS

By *Donald W. Clark*

MODEL builders who are tired of constructing ordinary airplanes and would like to try a flying boat design for a change will enjoy making this realistic *Gronland-Wal* seaplane (Capt. Wolfgang von Gronau's ship). White pine or balsa wood serves for most of the construction, and only twenty-five parts in all are required—not counting the hull cradle. Every one of these parts is easy to cut out, and the process of assembling them involves no difficulties, even for the beginner.

The model has a wing spread of 24 in., and the hull is 15 in. long. Its scale in relation to the full size seaplane is ⅜ in. equals 1 ft.

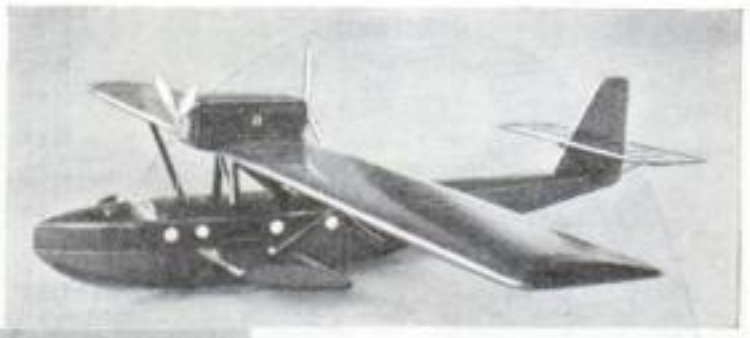
For the hull, plane a pine blank to 2 by 2⅛ by 15 in. Draw the cutting lines—that is, the top and side views—on the blank with pencil. Then shape it with saw and plane, and finish with sandpaper. Cut out the cockpit with a coping saw and make a slot vertically in the tail end to take the vertical tail. The horizontal tail is attached to the vertical tail by the slot method and braced with two metal struts *F* as shown.

Shape the wing from a pine blank ⅜ by 3 by 24 in. It is mounted on the hull with the seven wooden struts marked *C*, *D*, and *E*. Only the four struts *C*, however, are set into the wing and hull (see front view); the other three struts run diagonally. The four wing struts *A* and *B* are metal. Their upper ends should be fastened with small brads, and the lower ends set into slots in the floats as shown.

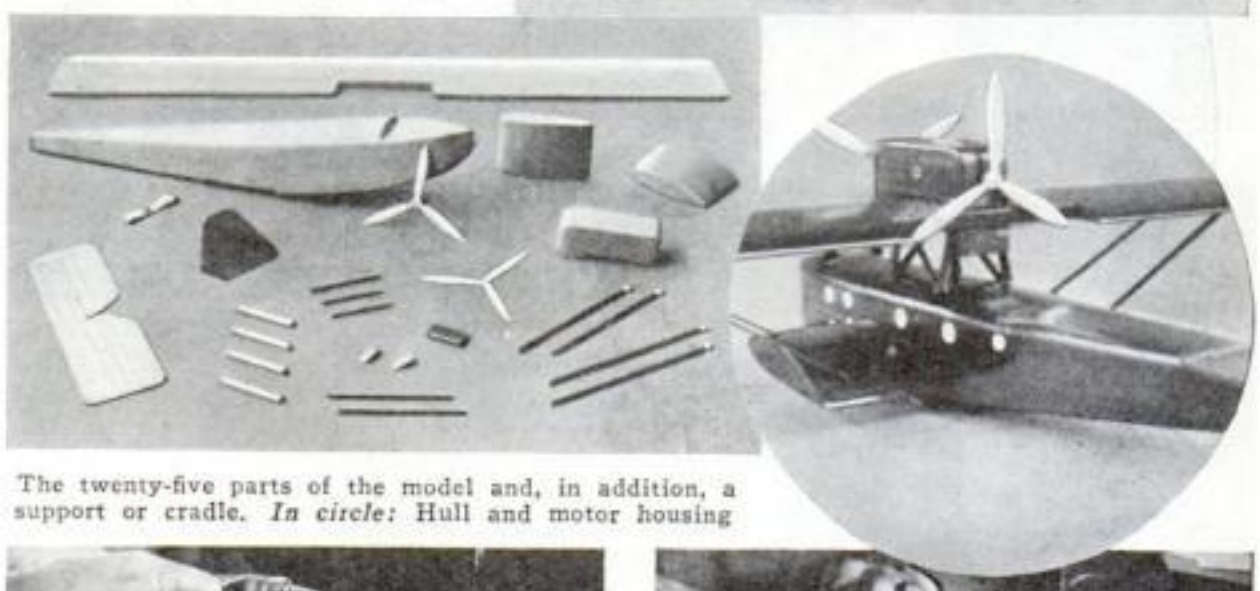
The floats can be shaped from wood blanks ⅞ by 2 by 3 in. Make one right and one left. Four wire studs 1 in. long will hold them securely in place.

Shape the motor housing from a wood blank 1 by 1¼ by 2⅞ in. Glue it to the top of the wing and glue the radiator to the bottom of wing, just behind the rear struts. Fasten the propellers to the motor housing with brads and place a small wooden washer between each propeller and the housing.

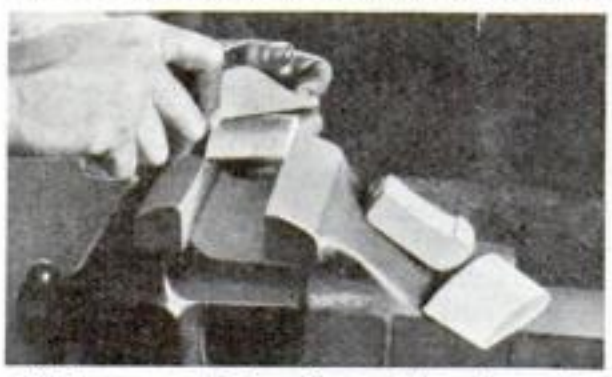
Paint the whole model aluminum and use black to indicate the exhaust ports, motor housing details, radiator lines, and round windows on hull, and also the hinge lines on the tail units. This model will also look well if painted Chinese red and trimmed with aluminum instead of black, as shown in the photographs. Polish the aluminum propellers.



The completed model is shown at the right. It is painted Chinese red and trimmed with aluminum, but looks equally well if finished in aluminum with black markings

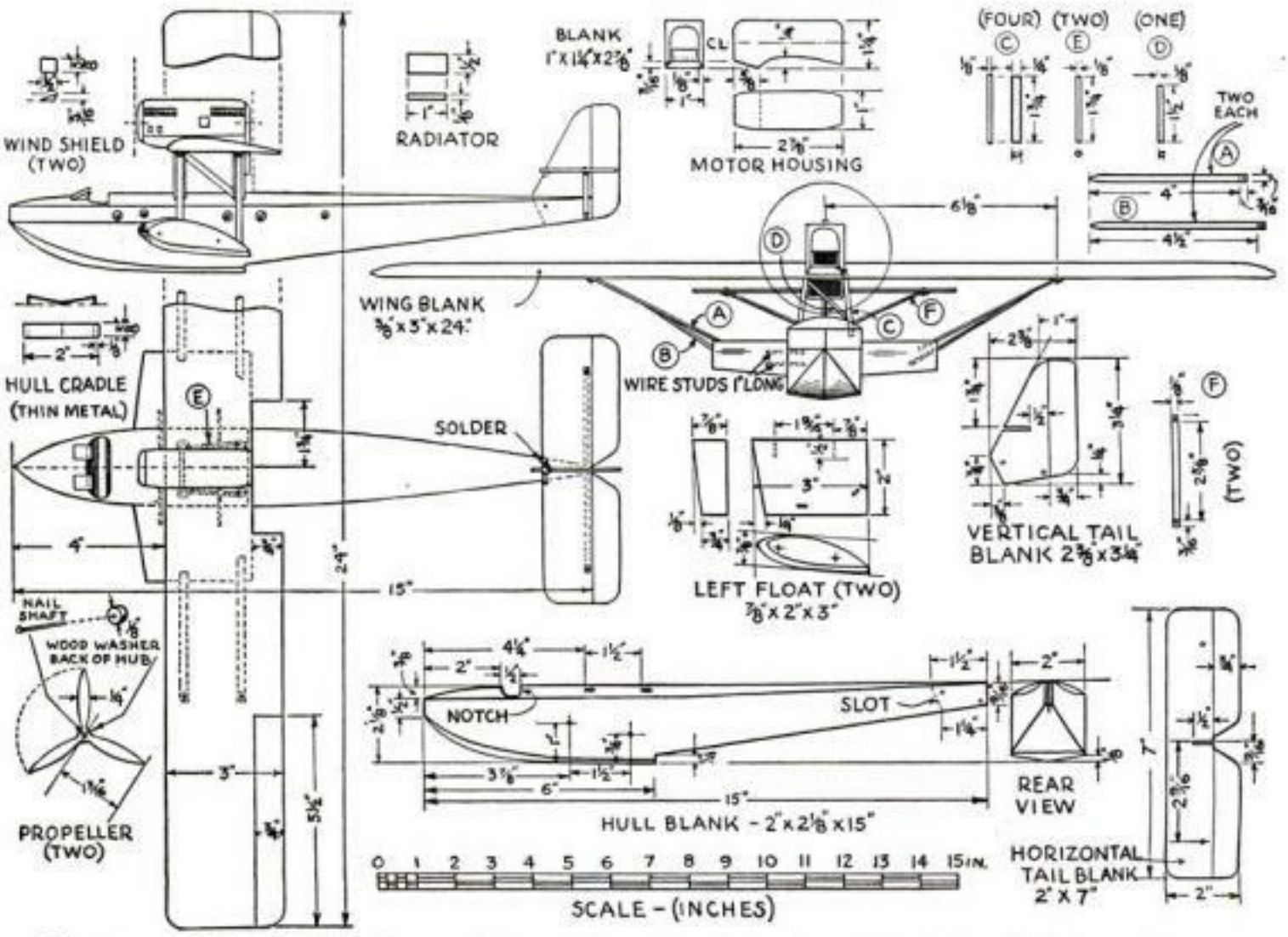


The twenty-five parts of the model and, in addition, a support or cradle. *In circle:* Hull and motor housing



Planing one of the floats. Note how the motor housing is cut out to fit over the wing

It is important to mark the holes for the wing-mounting struts accurately on the hull



Side, top, and front views of the assembled model, and detail drawings of the hull and all the smaller parts

SQUARE KNOTS

form intricate pattern in this

Woven Belt

By KENNETH MURRAY

A notched stick tied around the chest aids in holding the cords as at left. *In oval:* A well-knotted belt of exceptional durability

SQUARE-KNOT work, a pastime of sailors the world over, offers to the home craftsman a fascinating type of handiwork. Tiny knots, tied one next to the other, are so arranged as to form woven articles of unique design.

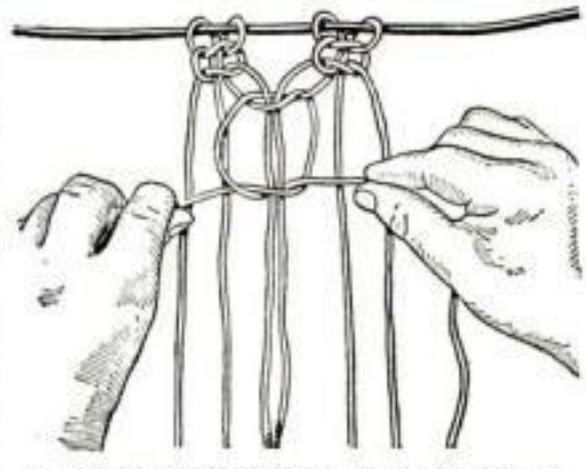
To make the durable and attractive square-knot belt illustrated, some No. 9 three-strand white cotton or linen cord and a nickel or mother-of-pearl buckle are the only materials required.

The cord is cut into double lengths, each being seven times as long as the finished belt. The start is made at the tongue or loose end of the belt by looping four double lengths over an anchoring cord fastened to the back of a chair or other convenient support. Square knots are tied in these as shown in Fig. 1, four cords being used to form each knot. To hold the two undercords taut while a knot is being made, twist them around a notched stick fastened around your chest with a cord as in the photograph above.

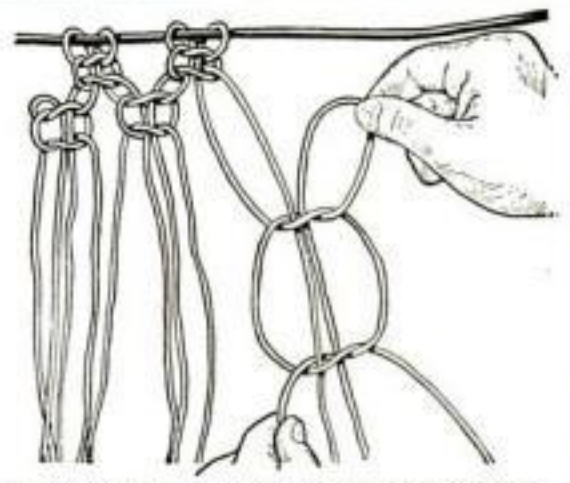
At the beginning, two doubled lengths are added to each new row of knots, one doubled length being introduced from each side as shown in Fig. 2. These cords are added to each new row until the belt reaches the desired width.

Designs are worked into the weave by skipping knots. In Fig. 3 a hole for the tongue of the buckle is being formed by skipping one knot. This is done by dividing the cords into two groups of equal number, knotting each group separately, and then knotting the inner cords of the two groups together as illustrated. Attractive twists in the center of the design can be made by dividing the cords into groups of four each as shown in Fig. 4 and knotting the inside groups with half hitches (ordinary knots). These automatically form into a twisted band. The two outside groups of four each are tied with square knots as shown in Fig. 5. Be sure, throughout the work, that the knots in each row are tightly drawn before proceeding with the next.

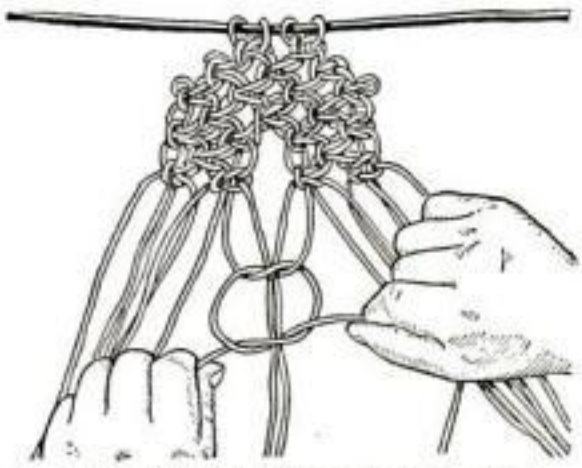
If you would like to see other designs for fancy knot work published, write to the Home Workshop Editor.



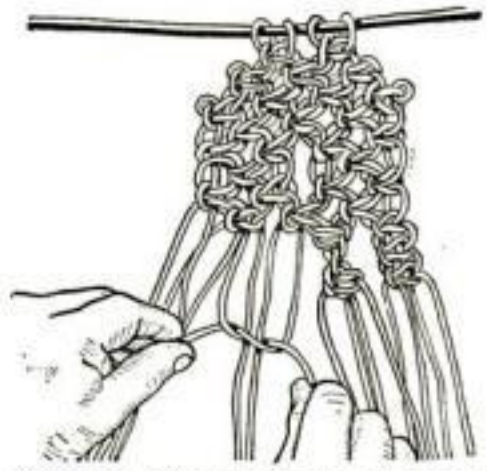
1 Four double lengths are looped over an anchoring cord and knotting is begun



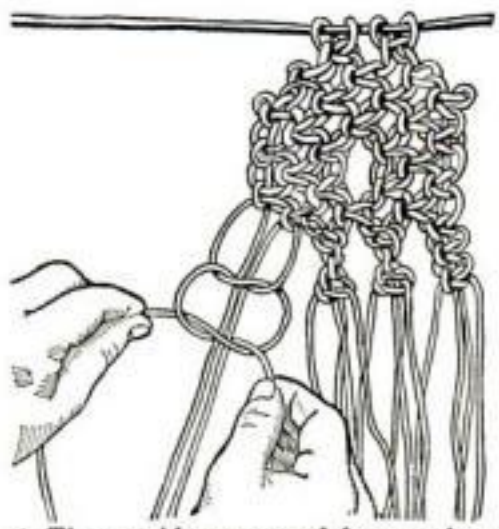
2 At every new row one doubled length is added at each side until wide enough



3 A hole is left by dividing the cords at the center and skipping one knot there



4 Twisted patterns can be obtained by tying inside groups with half hitches



5 The outside groups of four cords each, however, are tied with square knots

6 After the twists are made any desired length, continue with the square knots

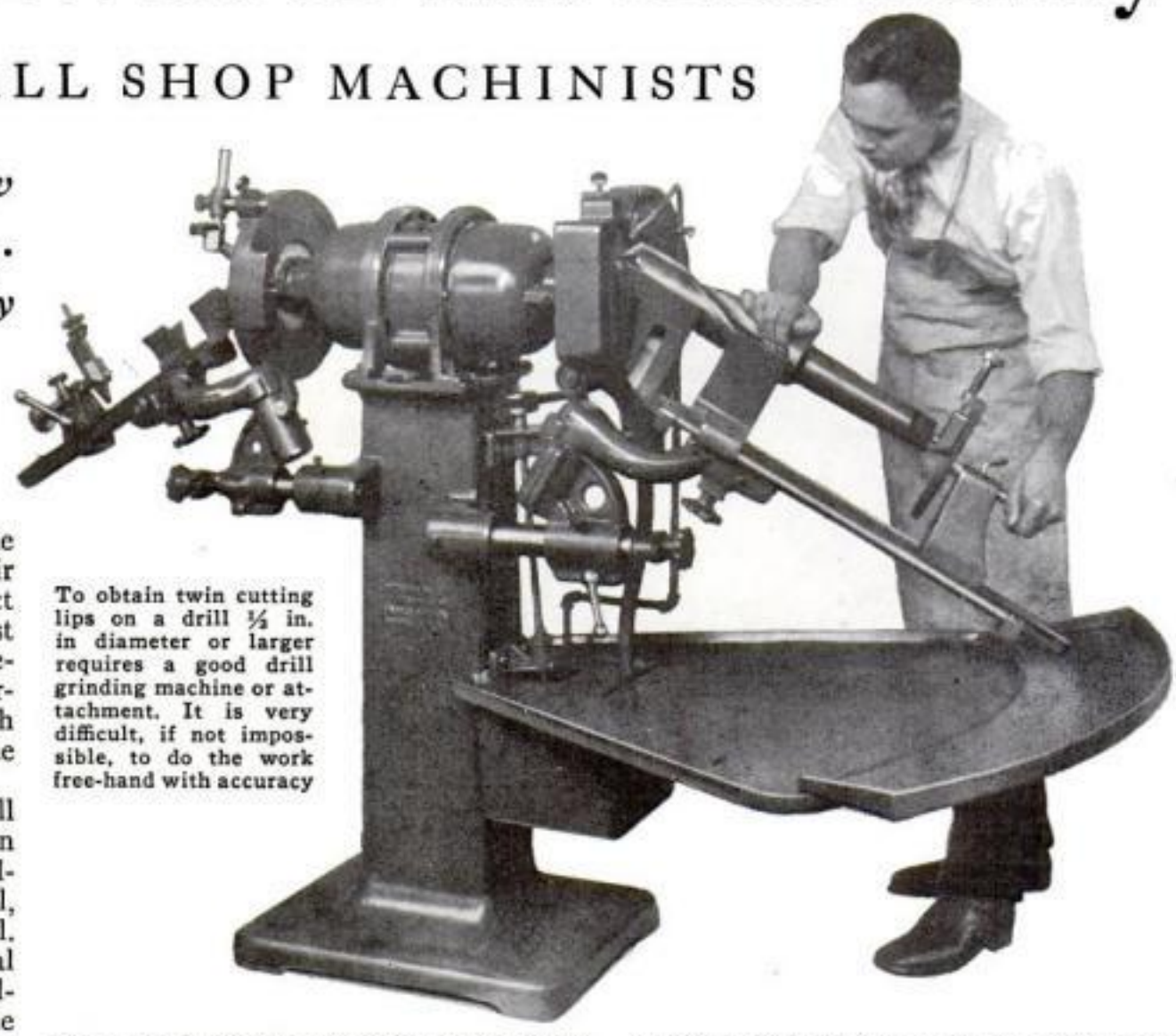
Hints on Twist Drill Economy

FOR SMALL SHOP MACHINISTS

Preserving twin lips . . . How to thin the web near shank . . . Starting big holes accurately

By

Hector J. Chamberland



To obtain twin cutting lips on a drill ½ in. in diameter or larger requires a good drill grinding machine or attachment. It is very difficult, if not impossible, to do the work free-hand with accuracy

BECAUSE twist drills are among the most frequently used tools, their maintenance has been the subject of more consideration than almost any other machine shop item. Nevertheless, the all-around machinist in the average small shop is not always familiar with the best ways to insure economy in the use of twist drills.

To some mechanics, of course, a drill is only a means for making a hole for an ordinary bolt, but a machinist or toolmaker is compelled to regard a twist drill, to some extent at least, as a precision tool.

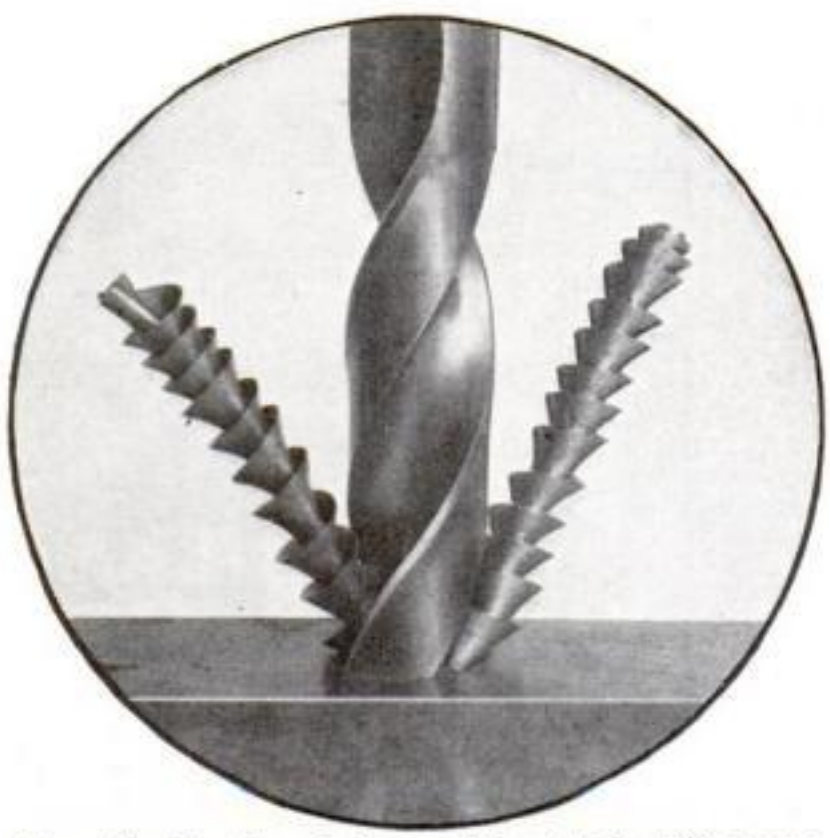
Large plants, through their individual systems of tool upkeep, get dollar for dollar on their drill investment, but in the smaller shops and job shops conditions have reached such a stage that these tools are anything but what they are intended to be. The reason for this is quite clear. The remaining mechanics all have access to the crib, and whether it is ignorance, neglect, or something else, one of the force will select the drill he wants, close his eyes to the drill point grinder on his way out, and attempt to sharpen it on any old grinding wheel he can find. This particular machinist or toolmaker may boast that he is a first-class man and that practice has made him a perfect drill grinder. On the other hand, the writer has every reason to make the statement that the average mechanic is yet to be found who can produce twin cutting lips on a drill ½ in. or larger by any other means than the use of some such machine as that shown in the photograph above. What nonsense for anyone to regard this equipment as a mere ornament, when drill manufacturers advocate its use as the basic solution for economical and accurate drilling.

It is a well known fact that drill troubles can rarely be blamed on the manufacturers. Drills have twin lips when they leave the factory. Medium and large drills are made either by milling flutes in round stock or by forging and twisting flat stock. The latter drill may be regarded as superior, as it evidently has more strength to resist twisting; still, the milled high-speed twist drill is good enough for any shop if it is given due care.

A successful drilling operation is a three-sided affair. First comes the drill point; second, speed and feed; third, rigidity of work and machine. Every apprentice boy knows the requirements of a drill point and is made to understand that unless the cutting lips are of equal lengths and equal angles and the clearance behind the lips is correct, no drill is of much value. There is also something else to remember: the included angle and clearance varies with the material to be drilled, which makes free-hand grinding a still more serious matter.

A copy of the chart given at *A* in the drawings, if pasted inside the cover of the tool box, will save some inconvenience at times. It is not the intention of the writer, however, to go into details as to grinding a drill point correctly. If the drill to be used is over ½ in., use the ordinary, common sense method and you will have no trouble. If the shop is so small that no drill grinder is available, at least use a gage and practice on old drills before you attempt to sharpen new ones. Any operator can get information on sharpening merely by writing to any large twist drill manufacturer.

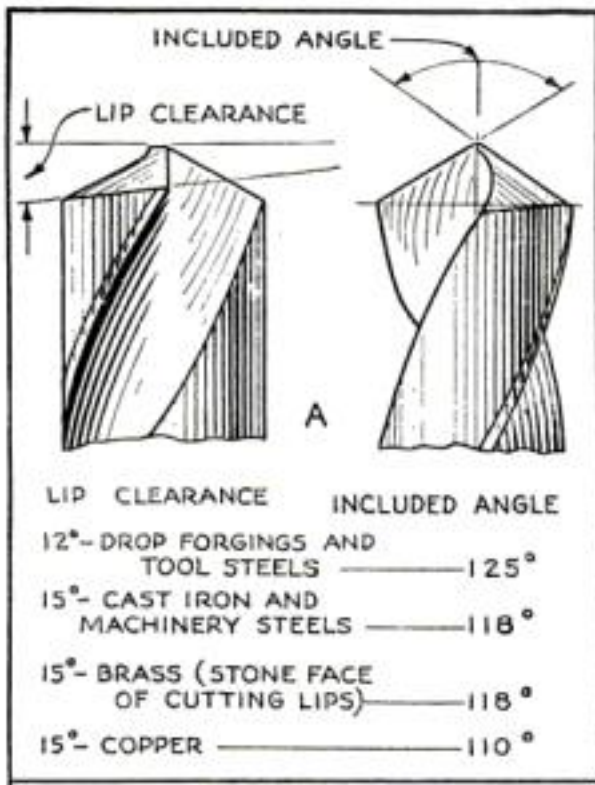
Next in importance to sharpening are the feeds and speeds. In this case the operator should use his head and, still better, refer to his machine shop handbook. It is better to favor speed than feed regardless of how perfect the drill point may be. Unnecessary speed will send a costly drill to the junk pile as fast as one that has some defect caused by a hand grinding operation.

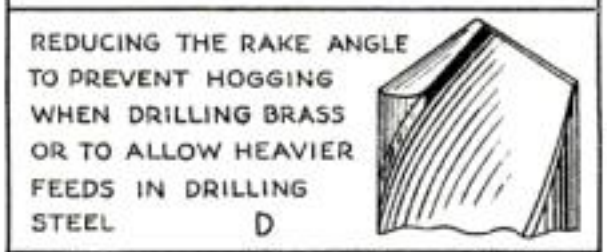


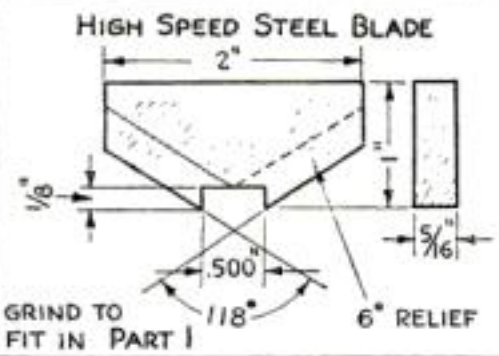
When chips like these circle smoothly out of the drill grooves, you need not worry about the efficiency of your drilling equipment

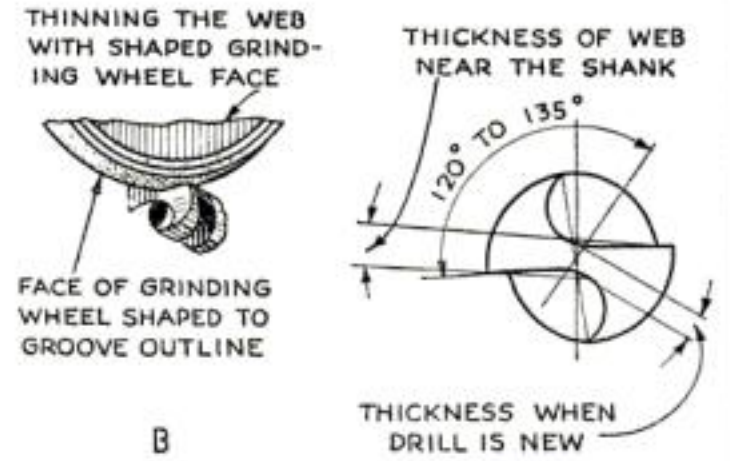
Generally speaking, the word "speed" in drilling means peripheral speed; in other words, the distance the drill would travel if it were rolled on its side and not the number of revolutions per minute (unless so stated). As for feed, it is well to bear in mind that a drill is not a corkscrew or a tap and will not pull itself in, therefore pressure is required to advance it. Such pressure is measured by fractions of an inch to a revolution. Evidently, the feed must be governed by the speed of the drill, its size, and the material being machined.

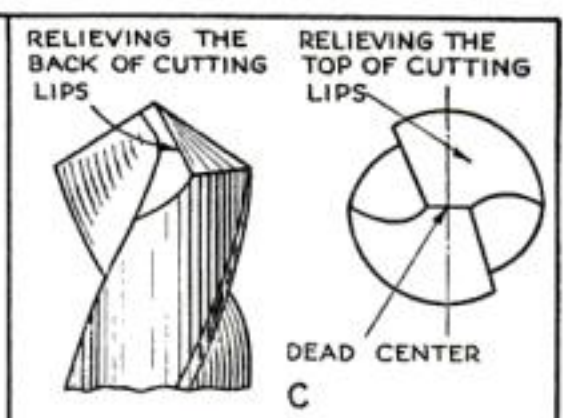
The third essential for accurate drilling is rigidity. Do not attempt heavy work on a light drill press. Any springing action in either the work or spindle is likely to break

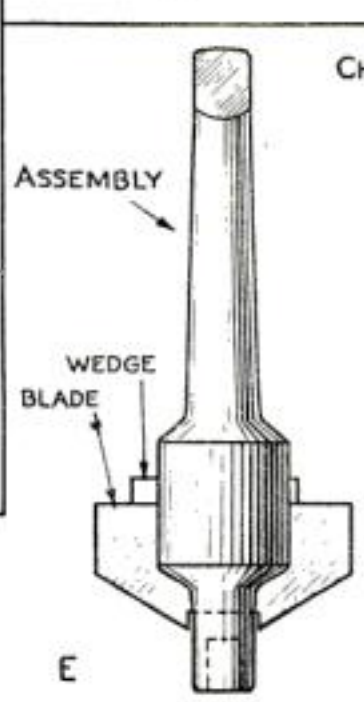


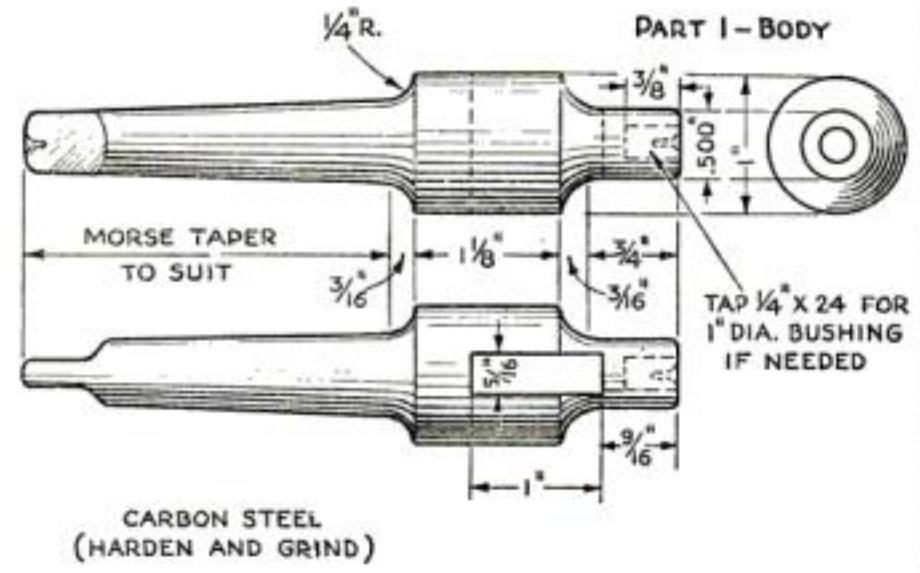












A chart to aid in sharpening twist drills *(A)*, the use of shaped and straight wheels for grinding flutes *(B* and *C)*, a drill point for soft metals *(D)*, and a chamfering tool *(E)*

the drill in two the instant the point pierces the bottom of the hole. If the work is not clamped to the table, the same trouble is likely to occur. The operator who holds work with his hand while drilling is not only cheating the company but is likely to pay a visit to the nurse.

If the chisel point of a substantial drill is too thick, it will cut hard. As the drill gets shorter, the web gets thicker; for good results, the thickness of the chisel point should be kept the same as when the drill was new. Web thinning has to be done by hand and it is no boy's job. If this operation is required, do it before grinding the point. There are two ways to do this. If you shape a grinding wheel to fit the flutes, you will get results as shown at *B*. If the operation is performed on a straight wheel, the point will appear as indicated at *C*.

When preparing to thin the web of a good drill, make a test on a discarded drill of the same size. The work must be done carefully or the drill will behave worse than before.

If a drill is correctly ground and still cuts hard, use turpentine for a lubricant and note the improvement.

Do not confuse the point of a drill with the dead center. The point is the entire cone-shaped surface at the cutting end; the dead center is the sharp point at the extreme thin end. The rake is the angle of the flutes. So that the drill will not hog in when cutting brass or soft metals, it is necessary to reduce the helix angle as shown at *D*.

If your drills are machine ground, you will get results as in the photograph at the bottom of page 78, which shows chips from a properly sharpened drill. If you take chances in grinding a drill, you will never know what to expect.

Drills usually are followed by reamers in accurate work, but sometimes it is required that a drill hole must be kept within close limits. One must realize that if a 1½-in. drill follows a much smaller one that acts as a lead, the two-point bearing of a two-lip drill against a square edge is not favorable to accurate results. If the work is being done in the lathe, a bearing ¼ in. wide and the same angle as the drill point should be cut on the edge of the lead hole. This will give ample support for the larger drill.

For use in an upright or radial drill, a chamfering tool made as shown at *E* will fill the bill. The ½-in. pilot will accommodate drills up to 1 in., and fitting a 1-in. bushing will give the tool a range up to 2 in. The idea will also prove economical with three- and four-lip drills and even for a reamer. If wear is apparent in the spindle of the machine, the scheme affords some compensation; and in any case, the better the start for the drill, the better the results.

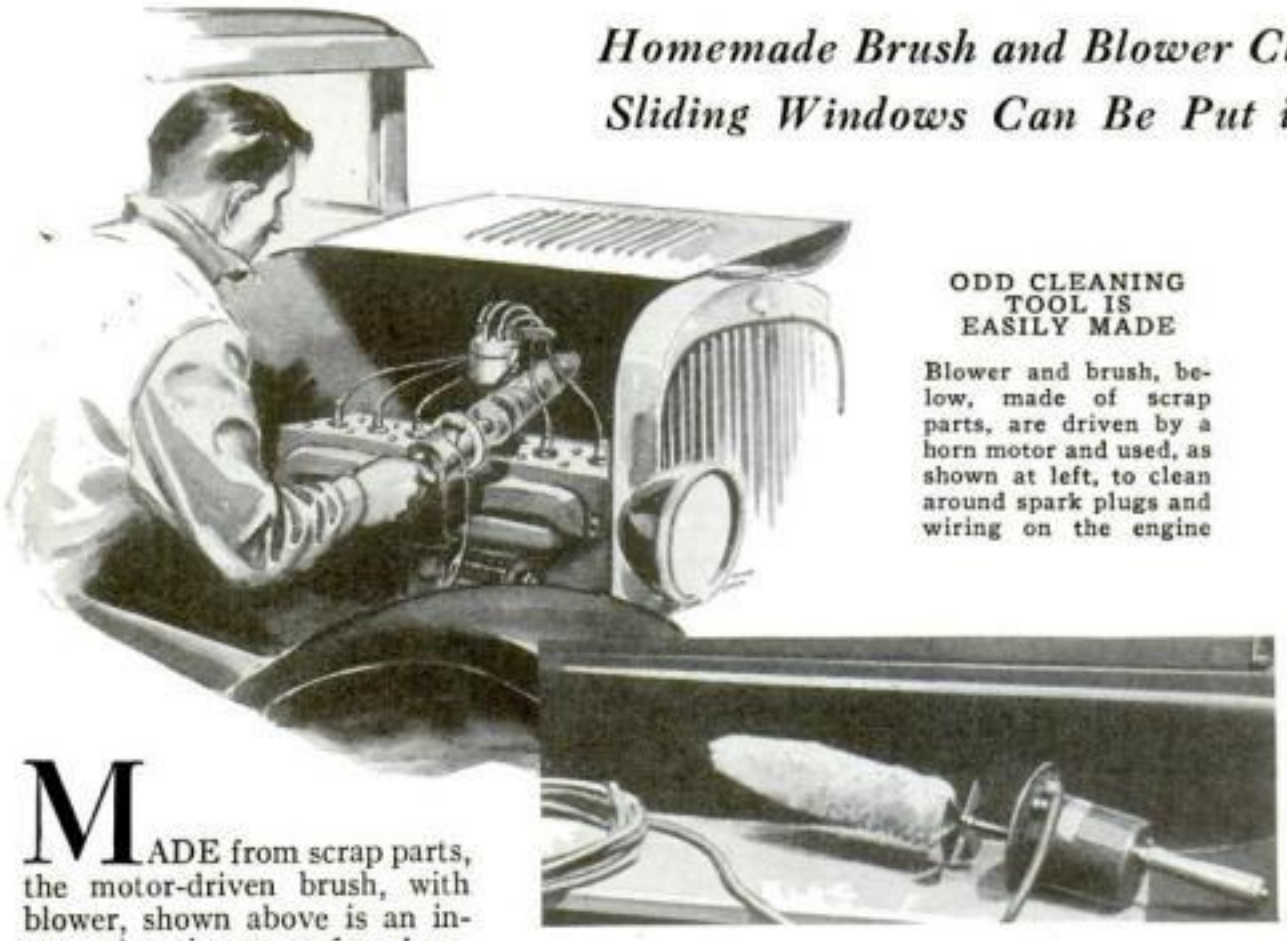
A new drill ordinarily is within .0005 in. of the marked size and will not cut more than from .001 to .002 in. too large if the above suggestions are followed. One must, of course, remember that drills are from .003 to .004 in. smaller in diameter near the shank than at the point, and this must be taken into consideration. Otherwise, when operating a sturdy radial drilling machine, anyone may conclude that if the holes are coming oversize the drill is to blame.

As closing suggestions on the care of large drills, keep the shank free from burrs, and when drifting a drill out of the socket, use a lead hammer and the regular drift key. Also, lay a board on the table to save the drill point.

A second article, scheduled for a later issue, will discuss in detail the care of drill chucks and tell how to regrind the jaws. It will also give hints on the use of small drills and a design for a simple cross drilling jig for round stock.

SHORT CUTS *for* Auto Jobs

Homemade Brush and Blower Clean Motor Quickly . . .
Sliding Windows Can Be Put in Open Car Curtains



ODD CLEANING TOOL IS EASILY MADE

Blower and brush, below, made of scrap parts, are driven by a horn motor and used, as shown at left, to clean around spark plugs and wiring on the engine

MADE from scrap parts, the motor-driven brush, with blower, shown above is an inexpensive timesaver for cleaning an automobile engine. The blades from a discarded electric fan of the midget type are mounted on the wire shank of a spoke brush from which the wooden handle has been removed. By means of a loop, a right-angle bend, and some solder, the end of the wire shank is then attached to the threaded end of the armature of a motor from on old horn. The handle taken from the spoke brush forms a convenient grip when attached to the rear of the horn motor housing. It is connected to the car battery by means of a suitable length of lamp cord.

Windows for Open Car

RIGID sliding glass windows can be easily installed in the side curtains of an open car. The wood frame, shown in Fig. 1 consists of four pieces, each having two 3/16-in. grooves to receive the two glass panels. The top and bottom pieces and one end of the frame should be fastened in place first, the stationary and movable windows slid in, and then the remaining side attached. The front glass can be held in place with cement.

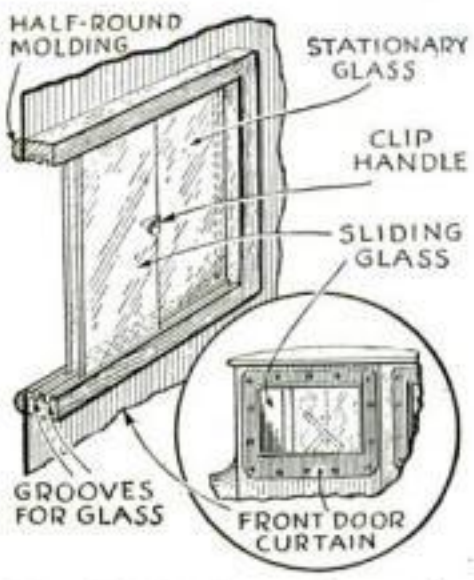


Fig. 1. Wooden frame set in curtains of open car can be fitted with glass windows that will open by sliding

Drive Shaft Tube

WHEN assembling the rear end of a car after repairs have been made, it is usually quite difficult to lift the drive shaft tube and at the same time guide the end of the shaft into place. However, if a long plank is placed over the rear axle and under the shaft tube in the manner indicated in Fig. 2, the long overhanging portion of the plank will counterbalance the shaft and leave the hands free to do the guiding.

Measure the Toe-in

BY CLAMPING a small, slide caliper rule to one end of a U-shaped wooden frame similar to that illustrated in Fig. 3, you can make a useful gage for testing the toe-in or "gather" of the front wheels on your car. The short horizontal members of the wooden frame should be located so that they are in the horizontal plane of the front axle when the gage is in place. To use the gage, place the frame between the rims at the front of the wheels and clamp the caliper in place in such a way that the head touches the rim when the slide is closed. Next, move the assembled gage to a corresponding position at the back of the wheels and open the caliper until the head touches the rim. The reading will be an accurate measure of the toe-in. The proper value for your particular car can be obtained from the general instruction booklet issued by the manufacturer.

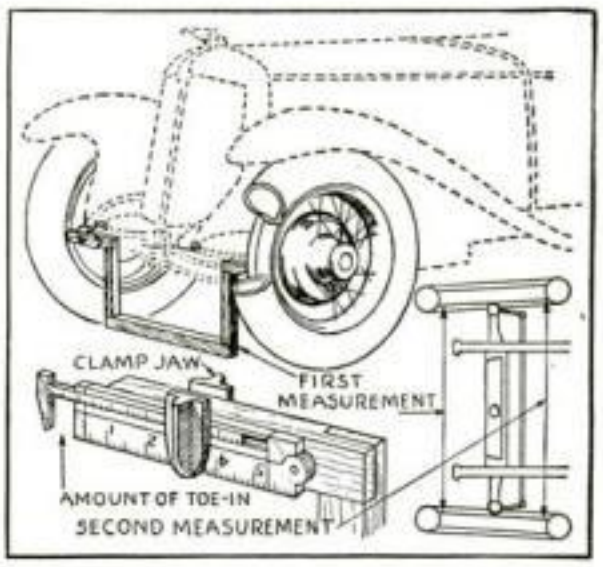


Fig. 3. By clamping a slide caliper to end of a U-shaped wooden frame, you have a gage that can be used to test the toe-in of front wheels

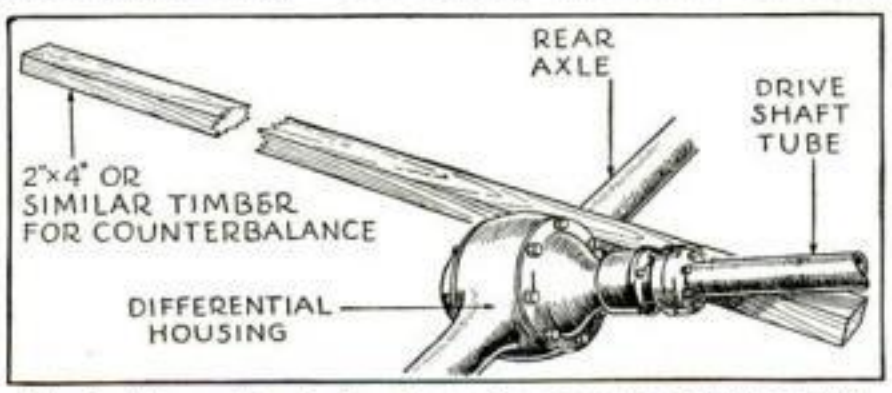


Fig. 2. A long plank is placed over the rear axle and beneath the drive shaft tube, to raise tube so the drive shaft can be guided home

Twin Guide Mirrors

TWIN mirrors fastened to the rear wall of a one-car garage will aid the driver when he backs the car through the narrow doorway. The mirrors, placed about ten inches from the side walls as in Fig. 4, should be adjusted so the driver can see the back fenders on each side. By looking first at one mirror and then at the other, it is a simple matter to keep the car centered in the doorway. The mirrors should be large enough to give a good view of the fenders and each side of the car. Suitable mirrors can be purchased in most five-and-ten-cent stores. Adjust each mirror by having someone hold it at various angles while you check the view from the driver's seat.

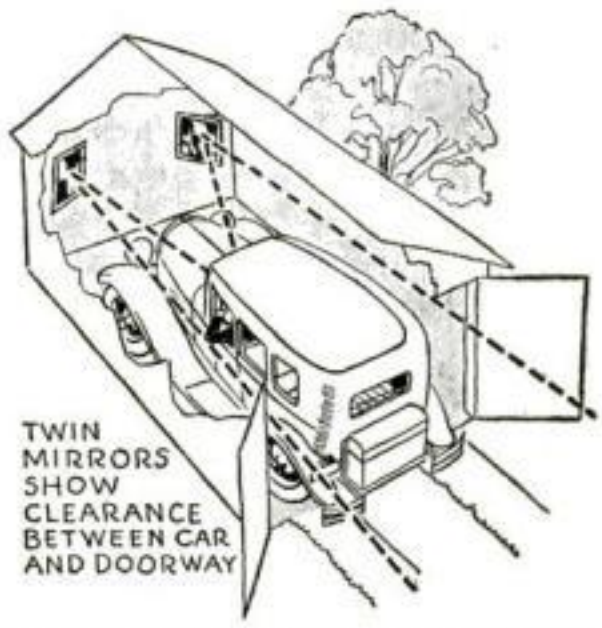
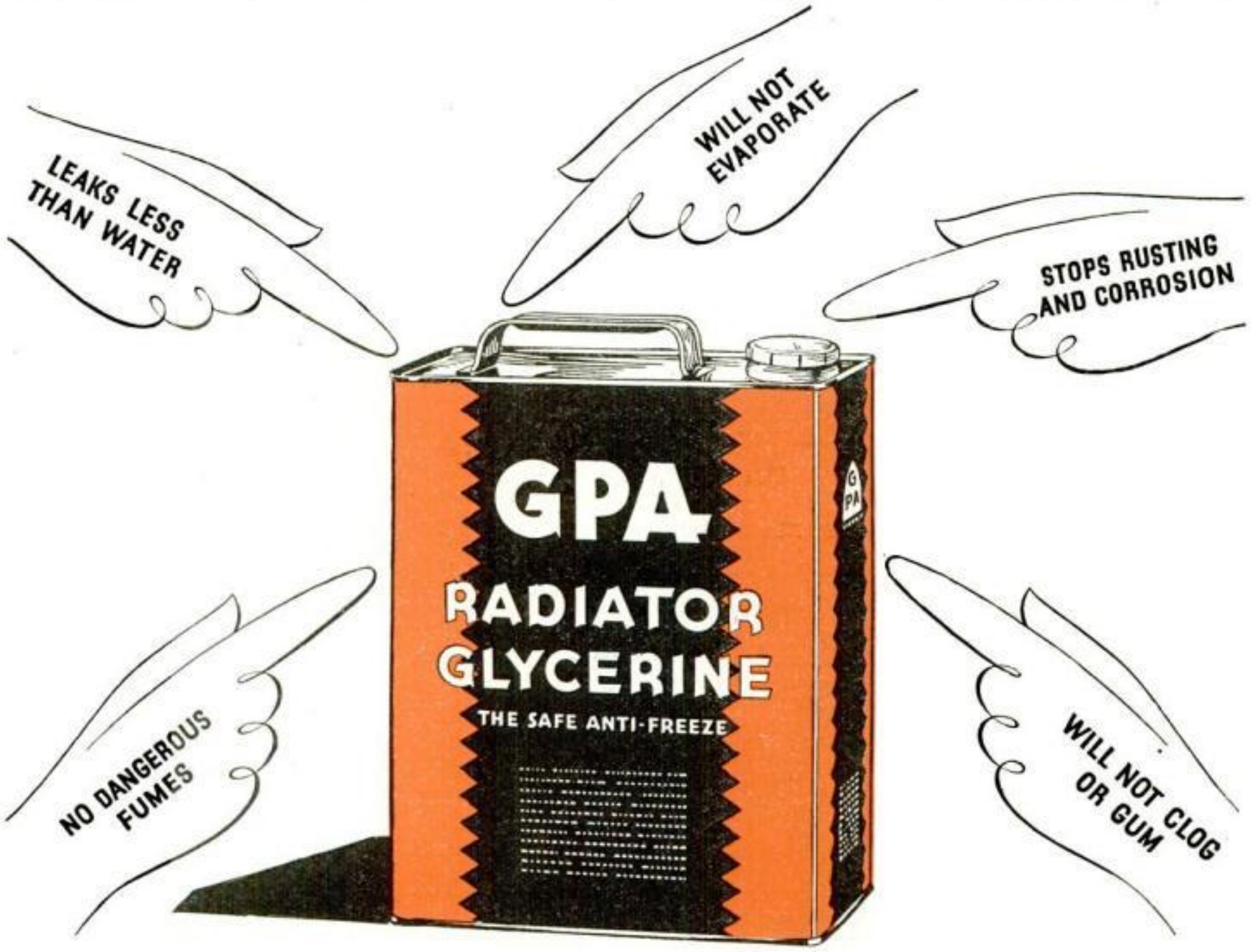


Fig. 4. Two mirrors, placed near the side walls of a small garage, guide driver in backing out

NEW! SAFER! COSTS LESS!



THE new G. P. A. is the anti-freeze *bargain* of 1932!

Not only is G. P. A. considerably lower in price but it is definitely better than ever for your car.

G. P. A. is, of course, permanent as always. It will not evaporate or boil away. One filling lasts all winter. No bothersome refillings!

Not only that, but the new G. P. A. *leaks less than water.* If your cooling system is water-tight, G. P. A. will "stay put" indefinitely.

Another remarkable feature of the new G. P. A.: It stops the rusting and corrosion caused by ordinary tap water; and this protection continues after G. P. A. is drained out. It also retards the disintegration of rubber hose. In every way it is better for your cooling system than plain water.

All in all, there are 14 important advantages of the new G. P. A. Read them carefully. See if G. P. A. is not the kind of anti-freeze you want this year.

Safer! Surer! Lower in price!

14 ADVANTAGES OF G. P. A.

1. Gives complete protection against freeze-ups to 30° below zero.
2. Will not evaporate—not even on the warmest days. One filling lasts all winter.
3. Leaks less than water.
4. Protects all metals of the cooling system against corrosion and the rust caused by tap water. This protection continues after G. P. A. is drained out.
5. Retards disintegration of rubber hose.
6. Positively will not clog or gum radiator.
7. Mixes quickly and permanently with water.
8. Never overheats motor.
9. Does not injure Duco or other finishes.
10. No unpleasant or dangerous fumes.
11. Safe—non-poisonous, non-inflammable.
12. Permits better operating temperatures.
13. Made to G. P. A. *quality*-standards.
14. Lower in price. More economical than ever.

● *FILL EARLY:* Since G. P. A. will not evaporate you can safely put it in early. Thus you avoid the last minute rush and all danger of early-season freeze-ups.

THE *new* G.P.A.
RADIATOR GLYCERINE

GLYCERINE PRODUCERS' ASSOCIATION, 45 EAST 17th STREET, NEW YORK, N. Y.

Improved Flashlight Methods Make it Easy to . . .

Take Your Best Photos *Indoors*

And perhaps you can win one of our new, greatly increased picture prizes

By Frederick D. Ryder, Jr.

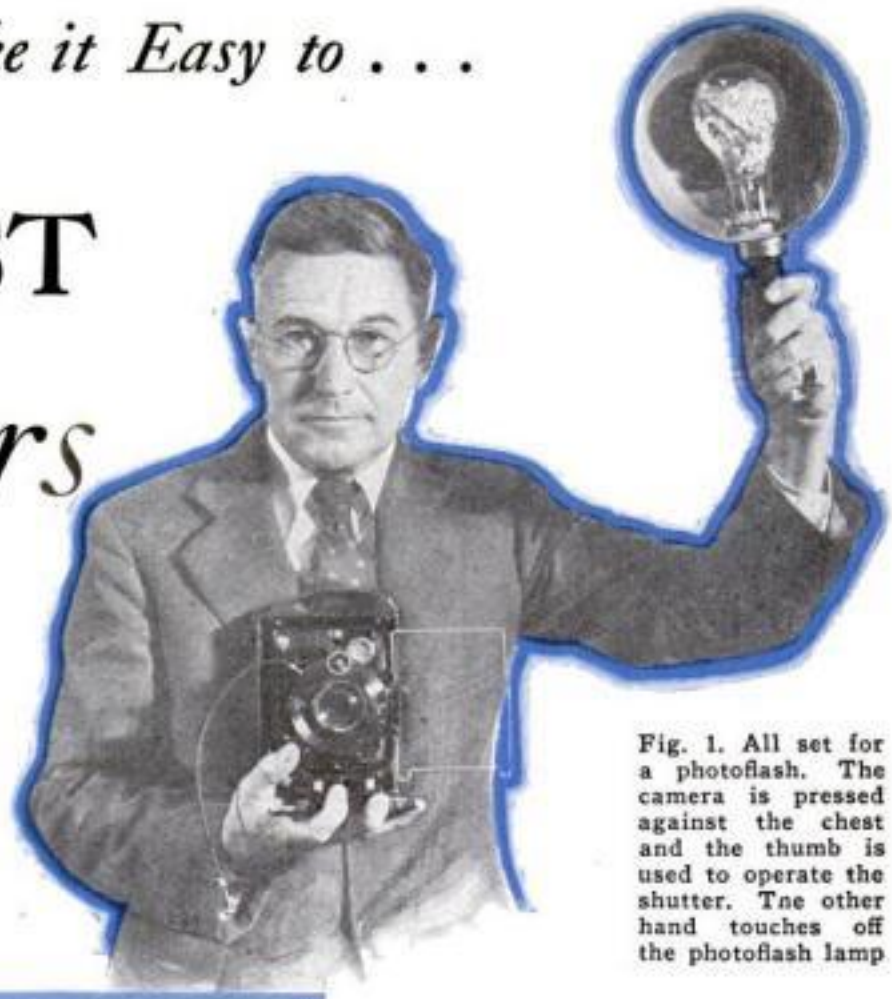


Fig. 1. All set for a photoflash. The camera is pressed against the chest and the thumb is used to operate the shutter. Tne other hand touches off the photoflash lamp

"PUTTING 'em in a plaster cast, or maybe freezing them solid is the only way, I guess," my seat mate on the bus excursion sighed as he shuffled a dozen photoprints. "I see you take pictures, too," he added, glancing again at the camera case between my feet. "How do you make children and animals stay still while you take their pictures? I can't. They move every time and this is what I get."

"Why don't you try 'freezing' them with a flashlight?" I suggested, as I examined the fuzzy prints.

"And scare them silly doing it," he scoffed. "Not to mention the dressing down the wife would hand me if I started filling the house with smoke and dust. Besides, all the flashlight pictures I've seen don't look natural. Everybody shuts their eyes when it goes off, or if you tell them to keep their eyes open, then you get that staring effect."

Fig. 2. This especially difficult photographic subject was lighted with a photoflash lamp so that all details can be seen. Even the scales on the fish are quite clear

This man, and many more like him, are way back in the dark ages of flashlight photography, when a flashlight picture was a serious, uncertain, and sometimes dangerous undertaking. Now, with the modern, properly compounded flash powder, flash sheets, flash cartridges, and especially with the new photoflash bulbs (Fig. 1), indoor photography by flashlight is so simple anyone can do it. Furthermore, flashlight photography, either by day or night, has certain advantages over shooting pictures by natural daylight or any other form of artificial light.

In the first place, the use of man-made light eliminates the need for guessing the exposure. A few test pictures will give you accurate knowledge of the strength of any source of artificial light. That settles the exposure question for good or until you change lights or the kind of film or plates you use. This is true with incandescent bulbs, photoflash bulbs, and even with flash powder, if the quantity used is accurately measured.

Secondly, you can arrange artificial lighting to give you just the effect you want—a difficult and often impossible job with daylight. With either the photoflood variety of incandescent bulb or the photoflash bulb, you can direct the light straight down, straight up, or at any desired angle.

The big advantage of the flashlight is its speed. While it is both possible and practical to take snapshots indoors by the aid of high-power incandescent lights, it takes several thousand watts of them, and you have to use fast and therefore expensive lenses and high-speed film. The

$100 *in* Cash Awards *for* Indoor Photographs

Here is a remarkable opportunity for you to make your camera yield a cash dividend and, at the same time, learn by practical experience how easy it now is to take good indoor photographs.

The introduction of photoflash bulbs has overcome all the old drawbacks of taking photographs in the house; in fact, you can be sure that every exposure you make will be successful. There is no noise, dust, smoke, or fire risk. Furthermore, the flash is so quick that it will not frighten the most timid child.

It is primarily to encourage you to learn to use this new modern method of taking indoor photographs that Popular Science Monthly offers six cash awards for the most photographically perfect pictures taken indoors by an amateur during the months of October and November, 1932. The photographs may be of any size, type, or subject, and, of course, daylight or any kind of illumination or flashlight may be used. The prizes are as follows:

FIRST AWARD	$50
SECOND AWARD	25
THIRD AWARD	10
FOURTH, FIFTH and SIXTH AWARDS, $5 each	15
TOTAL	$100

Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photograph Editor, Popular Science Monthly, 381 Fourth Avenue, New York, not later than December 1, 1932, and mark your entry "November Photo Contest." Also write on the back of the negative what illumination was used—daylight, artificial, or flashlight, and if flashlight, which type. You may enter several pictures if you wish, but no entries will be returned. This contest is open to all except employees of Popular Science Monthly and their families. In case of ties, each tying contestant will be awarded the prize tied for.

Bill learns how to take INDOOR PICTURES

One of the photographs Bill took with G.E. MAZDA *Photoflash lamps*

G.E. MAZDA *Photoflash lamp*

G.E. MAZDA *Photoflood lamp*

All of these photographs taken with G. E. MAZDA *Photoflash lamps*

Here's the secret of PRIZE-WINNING INDOOR PICTURES

TO take *Action* scenes with "still" cameras, inside the house or outdoors at night, use G.E. MAZDA *Photoflash* lamps. They operate simply, from house current or flashlight batteries. A quick brilliant flash and the picture is yours. No noise, smoke, or muss. A new picture calls for a new lamp. Indispensable for shots of babies and children.

To make time exposures . . . portraits . . . interiors . . . indoors or at night, use G.E. MAZDA *Photoflood* lamps. They operate on ordinary house current and give good pictures with 1 to 5 second exposures. During the two-hour life of these lamps, many pictures can be made. The new G.E. MAZDA Photoflood lamp is the best lamp ever developed for taking home movies.

• • •

Ask your druggist or photo-supply dealer about these two new aids to indoor picture-taking. Better still, get some and try them. That will convince you. General Electric Company, Nela Park, Cleveland, Ohio.

GENERAL ELECTRIC CO., *Nela Park, Cleveland, Ohio* P. S. M. 11–1932

FREE Please send me, free, the folder "How to make GOOD pictures indoors."

Name _____ *Address* _____

City _____ *State* _____

GENERAL ELECTRIC

MAZDA PHOTOFLOOD and PHOTOFLASH LAMPS

flashlight allows the same result with an ordinary camera and the film you regularly use.

The photoflash bulb, because it makes no noise, no smoke, and cannot cause fires, is ideal for home photography. The duration of the light from a photoflash bulb is about a fiftieth of a second. This is roughly equivalent to the speed of normal flash powder fired from a suitable type of flash gun. An exposure of this length is too long to stop fast motion, but it is ample to "freeze" the normal wrigglings of a small child or animal pet into a sharp picture.

One peculiarity of the photoflash bulb is of great value—the virtual absence of the glare that causes subjects to blink or squint in anticipation. Experienced photographers, trying photoflash bulbs for the first time, can hardly believe that the sudden, lightninglike flicker of light is strong enough for picture taking.

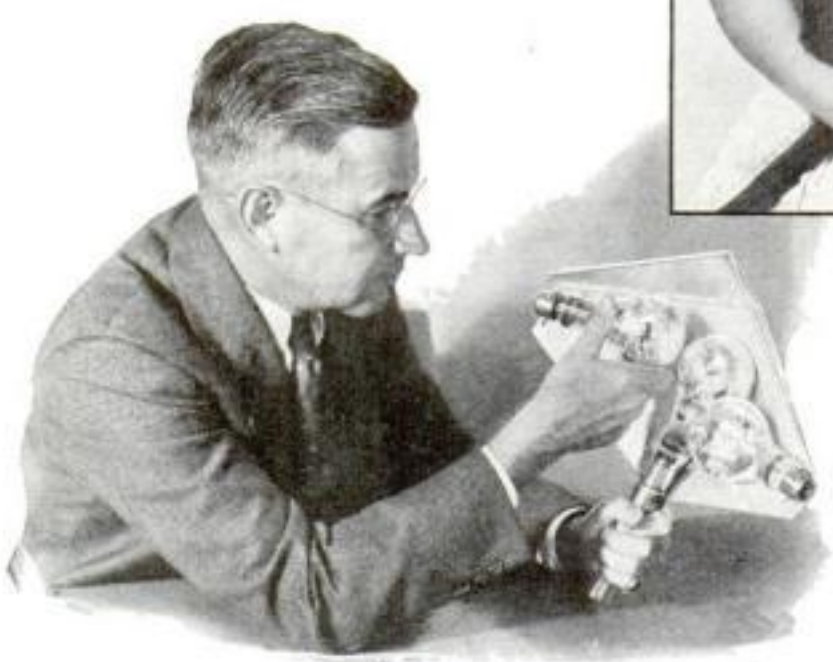


Fig. 5. Three photoflash bulbs can be set off at once by placing the extra ones in contact with the central bulb

In order to show the differences between photography with electric lights and with flashlight, I took the two pictures shown in Figs. 3 and 4. The second is the best of three attempts to take a picture of a child and kitten with the aid of a 500-watt bulb and an ordinary camera. Many a disgusted amateur photographer has thrown pictures like this into the wastebasket. If the kitten had held still for a fraction of a second longer and the little girl could have been induced to stop squinting because of the bright light, this might have been a good one. In the other two tries, the child appeared to be holding a fuzzy black shadow.

Now look at Fig. 3. Here are the same subjects photographed with the same camera under exactly the same conditions except that a photoflash lamp was used instead of a 500-watt bulb. See how quiet the little black imp of a kitten appears in this view. Of course he wasn't really quiet, but the photoflash lamp stopped him. Note, also, the soulful, wide-eyed expression the child chose to assume in this "shot." Yet there is nothing squinty or strained about it because the normal lighting of the room, which was kept going, allowed a natural and easy pose. It is extremely difficult, if not impossible, to get such an unstrained expression in the bright sunlight that permits snapshots with the ordinary camera.

Fig. 3 *(left)*. Taken with a photoflash lamp. Note naturalness and sharp detail

Fig. 4 *(below)*. What happened with artificial light. The pose could not be held

Cats are proverbially quick, yet you will note the wide open eyes of the kitten in Fig. 3. I watched its eyes while this picture was being taken and sure enough, they blinked, but not till a split second after the flash.

Keep this matter of winking in mind when you take flashlights. Watch your subject's eyes and time the flash to come between the normal winks.

Figure 2 shows another difficult picture-taking problem easily solved with a photoflash bulb. It was held almost vertically above the surface of the water in the aquarium and high enough to be out of the field of view of the camera lens. Except for the slight degrading of detail caused by the molded glass side walls, the flashlight brought out every tiny object.

No apparatus beyond what you already have in the house is required to use photoflash bulbs. They can be screwed into any droplight socket and set off by turning on the current. Be sure the current is turned off before you screw the bulb in place.

It is, however, worth while to use a special reflector fitted with a handle containing an ordinary two-cell flashlight battery. The aluminum surfaced reflector sends all the light where you want it, and the battery eliminates the need for a drop cord to the wall socket.

In case you depend on the house lamp, a homemade reflector that has been given a couple of coats of aluminum paint or covered with aluminum foil will give you good results.

Figure 5 shows what to do when the conditions demand more light than can be obtained from one photoflash bulb. The special folding reflector shown is fitted with clips to hold one or two extra bulbs with their big ends touching the glass of the bulb that is to be fired by the battery. Just why extra bulbs should go off when the center one is fired is not known but the fact remains that they do. If you have no especially equipped reflector, the extra bulbs can be tied with string beside the bulb in the ordinary reflector. Be sure the glass surfaces actually touch.

Always test the lighting before you attempt to take a flashlight, whether you use a photoflash lamp or any other flashlight. This is easy to do. First place any available electric light bulb in a socket on the end of a drop cord. Turn on the current to the test bulb and turn off all the rest of the lights in the room. Now hold the test light in various positions and note which lights the subject most attractively.

The reason why the rest of the lights in the room should be turned off is because they will have no effect on the picture taking and therefore should not be allowed to influence the test.

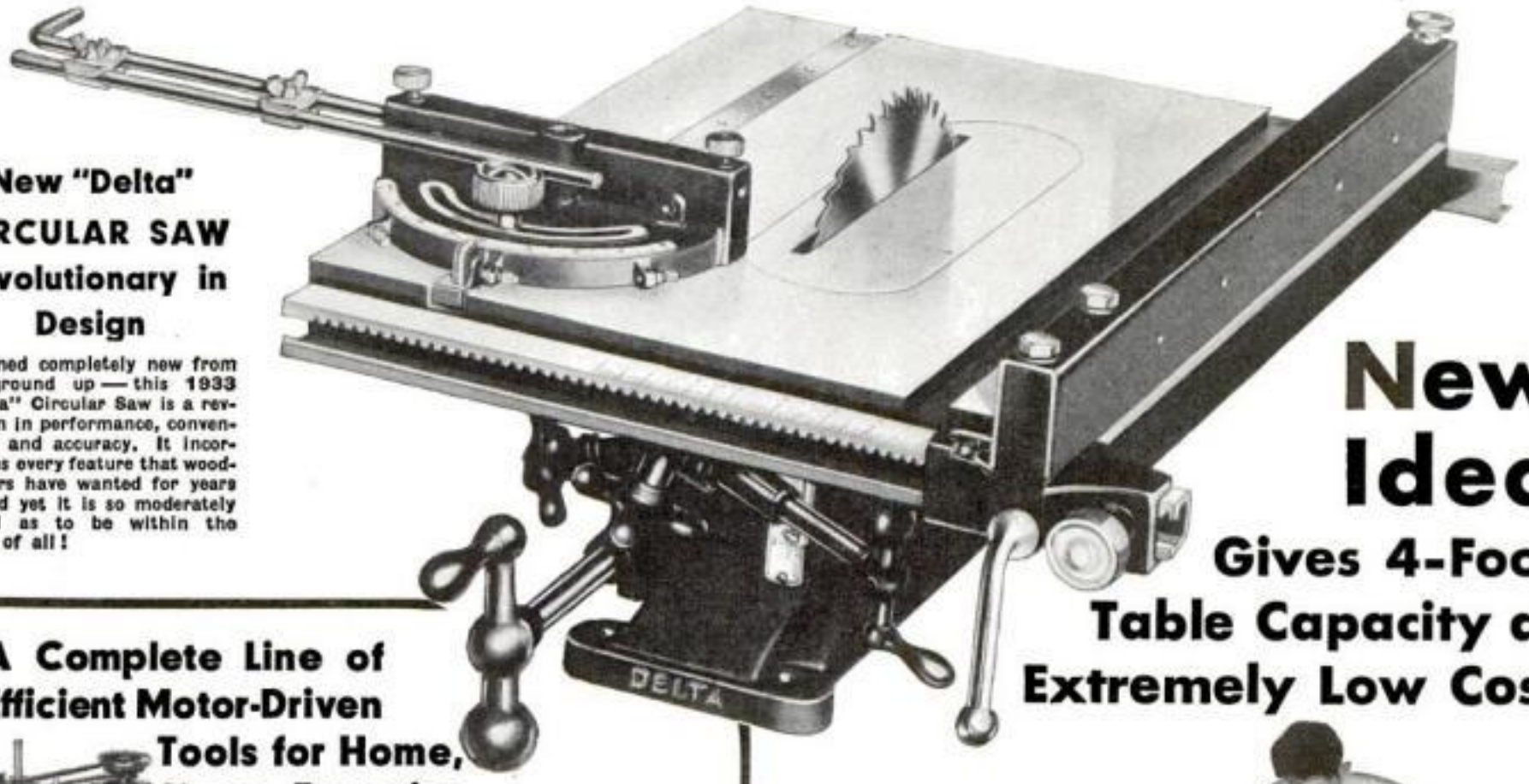
Ordinarily, the best position will be above the camera and on a line making an angle of approximately forty-five degrees with a line drawn from the lens to the center of the subject.

JULY PHOTO CONTEST AWARDS

FOR the best photograph submitted in our July Photo Contest (P. S. M., July '32, p. 94), C. O. Mock, of Lexington, Ky., has been awarded a prize of $10. The following won honorable mention in the same contest: Joseph Baldorff, Cincinnati, Ohio; Tom Griberg, Moline, Ill.; Forrest Huff, Jr., Jamaica, N. Y.; William W. Lange, Chicago, Ill.; F. Paul Luther, Pulaski, N. Y.; Paul Moore, Greenville, Tenn.; H. N. Mucher, Reading, Pa.; B. J. Smyth, Oberlin, Ohio; Robert Stauffacher, Claremont, Calif.; Eddie Webster, Lewiston, Idaho; V. M. Whick, Montreal, Canada. The winner of the August contest will be announced next month.

New 1933 *Delta* Tools

Set New Standards for Motor-Driven Woodworking Units



New "Delta" CIRCULAR SAW Revolutionary in Design

Designed completely new from the ground up — this 1933 "Delta" Circular Saw is a revelation in performance, convenience, and accuracy. It incorporates every feature that woodworkers have wanted for years — and yet it is so moderately priced as to be within the reach of all!

New Idea Gives 4-Foot Table Capacity at Extremely Low Cost

CIRCULAR saw users have always wanted a large saw table. The 1933 "Delta" Circular Saw provides this with a vengeance! Through a remarkable new method this new tool gives both extra space in front of the saw, where it is most needed, plus all the advantages of a table 4 feet square, at a fraction of the ordinary cost of a very large table. In addition, this unusual tool offers an amazingly improved Miter Gauge, a new and better self-aligning Rip Gauge, and improved accurate lowering and raising mechanism plus numerous other important new features. Above all—"Delta" engineers, after painstaking tests under all conditions, have made this a Tilting Table design (no tilting arbor, no loss of power). For full details send the coupon below today for the FREE 1933 "Delta" Catalog.

A Complete Line of Efficient Motor-Driven Tools for Home, Shops, Factories

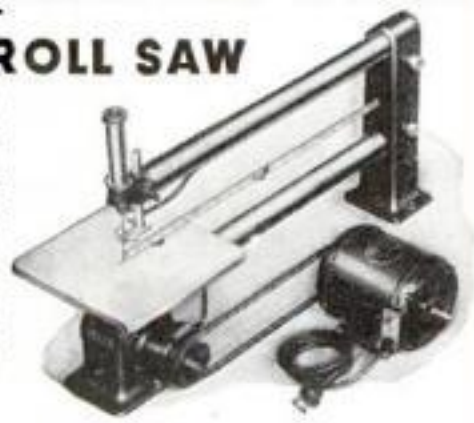
NEW tools, startling improvements, added accessories feature the 1933 "Delta" line of woodworking units. Into each tool has been built the same quality and careful workmanship that has made "Delta" the standard for motor-driven units the world over. The sturdy construction, compact, convenient design, portability, and low initial cost make these "Delta" tools equally desirable for use in factory production and home workshop. Many thousands of professional woodworkers and home craftsmen testify as to the splendid performance of "Delta" tools on the most difficult jobs. That's why they say: "'Delta' offers the most machine value per dollar!"

New "Delta" DRILL PRESS

It would take almost a book to describe completely the features, advantages, and range of operations of this sensational new addition to the "Delta" line. Briefly, the new "Delta" Drill Press, measuring 68 inches high and provided with heavy floor base, is a precision tool—built to meet the most exacting demands of production work, and yet priced unbelievably low. It incorporates numerous new features, including Ball Bearing Spindle, Accurate Graduated Chuck, Tilting Table, Enormous Capacity, and many more. It is really two machines in one—as the head can be reversed and used efficiently as a Shaper. Hollow Chisel Mortising Attachments available. For full details see the New "Delta" 1933 Catalog.

New "Delta" SCROLL SAW

Radically different from any Scroll Saw on the market. It runs at full motor speed—1800 strokes per minute—all springing and twisting eliminated, with perfect balance and absence of vibration. As a result, this remarkable tool produces fine, smooth and accurate work hitherto only possible on a band saw. **Has 24-inch throat capacity and will saw wood 2 inches thick!** Works on metal and fibre as well as wood. Has numerous special features. It can be used for filing, sanding, and honing.



New "Delta" COMBINATION UNITS

"Delta" Combination Units are convenient, portable, and compact. All are mounted on benches or stands—and are available in a large variety of combinations and at prices to fit all needs. These various combinations of "Delta" Tools are described in complete detail in the 1933 "Delta" Catalog. The "Delta" line includes Jointers, Circular Saws, Band Saws, Woodturning Lathes, Drill Presses, Scroll Saws, Boring, Routing, Sanding and Mortising Attachments, and a complete line of accessories.

10 Day Trial *EASY TERMS*

Because "Delta" Woodworking Tools are efficient and practical under actual working conditions, they are always available for a 10-Day Trial without the slightest risk. Satisfaction is guaranteed. For full details of this liberal offer and also of "Delta's" Easy Payment Plans, fill in and mail the convenient coupon which appears below—TODAY!

Catalog Free

Every man who works with wood—in factory or home workshop—will want to see this FREE 1933 "Delta" Catalog of Quality Woodworking Tools. It shows the complete line of latest "Delta" Tools. It is packed full of interesting illustrations and descriptions. It describes the latest developments in motor-driven equipment at the astonishingly low 1933 price levels. Be sure you get your copy! Fill out the coupon below and mail it TODAY!

DELTA MFG. CO.
3775 North Holton Street
Dept. B1132
Milwaukee, Wisconsin

DELTA MFG. CO., 3775 N. Holton St., Dept. B1132, Milwaukee, Wisconsin

Please place me, without obligation, on mailing list to receive the FREE 1933 "Delta" Catalog of Quality Woodworking Tools. Also send full details of your 10-Day Trial Offer and Easy Payment Plans.

Name.....Age?.....

Address.....

City.....State.....

Covering Our New KAYAK with Canvas

Tacking the canvas along the outside of the cockpit coaming. This can be done more easily if you have a helper

By JACK HAZZARD

ONCE you have completed the framework of the new POPULAR SCIENCE MONTHLY 16-ft. kayak, or Eskimo type canoe, as described in two previous articles (P.S.M., Sept. '32, p. 57, and Oct., p. 70), the application of the canvas covering is a comparatively simple matter.

Two sizes of tacks will be needed—5/16-in. to take the strains and ¼-in. to hold the canvas closely and work out wrinkles. If a piece of 10-oz. duck 60 in. wide can be obtained, it will be ideal, but a length 30 in. wide joined along the keel will serve practically as well.

Sand all varnish off the bottom of the keel and coat the wood well with glue. Lay a strip of the canvas in the glue, carrying the selvage to the far side of the keel, and tack in place every foot or so. Do not stretch too tightly. Apply glue to the edge of the piece tacked to the keel and press an additional breadth in place, lapping it just the width of the keel and tacking with large tacks every 2 in. and with small tacks every ¼ or ½ in. Stagger the small tacks, but keep the large ones on the center line.

Starting amidships on the side, pull the canvas over smoothly but not too tightly, and tack to the outer face of the inwale with large tacks, driven down hard. Work along one side for a few feet each way, then tack the corresponding section on the opposite side.

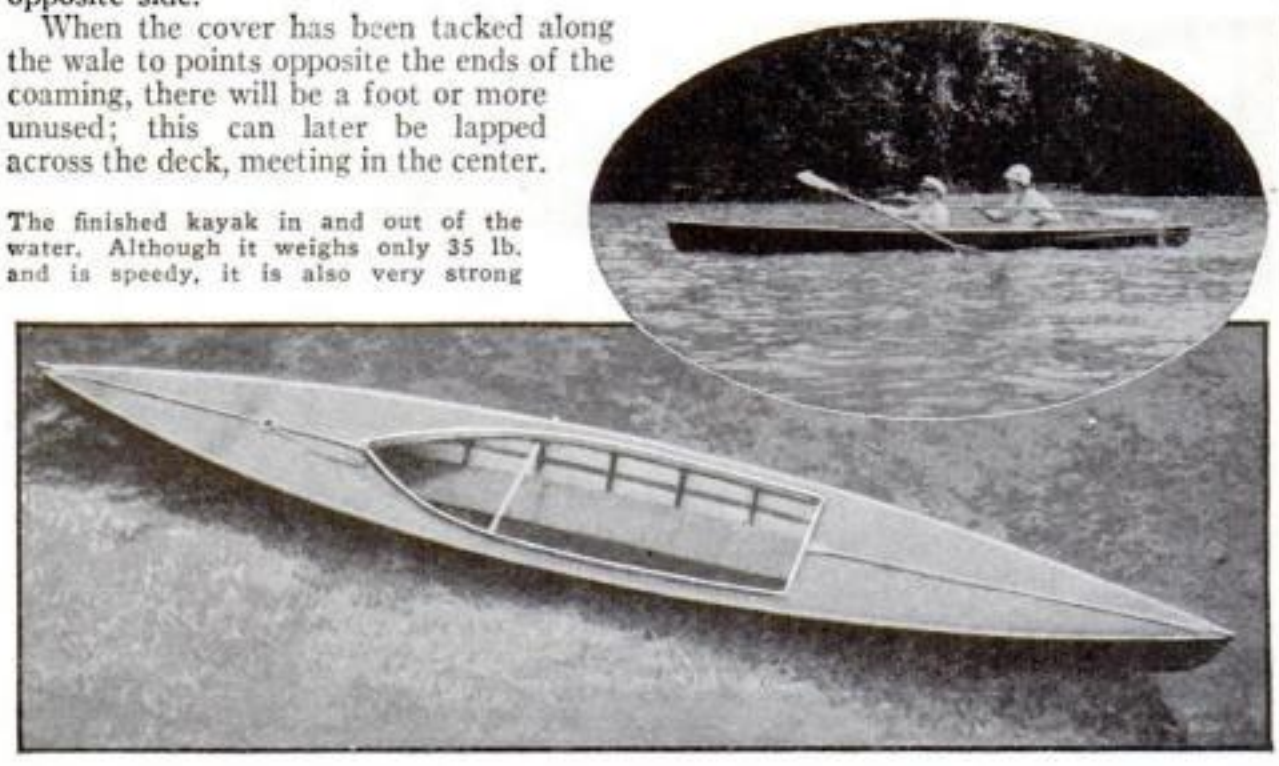
When the cover has been tacked along the wale to points opposite the ends of the coaming, there will be a foot or more unused; this can later be lapped across the deck, meeting in the center.

Before tacking all the way to the stem head, start tacking along the cutwater, which should be well coated with glue as the work progresses. Tack the canvas from one side first, using small tacks spaced at 1- and 2-in. intervals. Cut off the excess cloth, coat the canvas immediately over the cutwater with glue, and, folding over the cloth from the other side, repeat the tacking, this time spacing the tacks from 1/16 to ⅛ in. apart and driving them in firmly. Wipe off all excess glue and leave ½-in. of cloth projecting until the glue has dried. The bang plate will cover all the tack heads. Use care in spreading the glue as the paint will not adhere to it very well.

When the cover has been tacked along the keel, stems, and wales, give the inside a coat of airplane dope, being careful not to spread it on the frames or longerons because it whitens the varnish.

Lap the remaining canvas over the decks and glue and tack one side to the ledge outside the cockpit coaming and along the center stringers. In stretching the deck canvas along the cockpit, pull it across the top of the coaming and force it down into the glue spread on the ledge, tacking at 1- and 2-in. intervals with small tacks. Complete the tacking with large tacks and coat the canvas for ¼ in. with glue. Cut the excess away with a sharp knife where ledge and coaming meet. The rough edge will later be covered by quarter-round oak molding. Now work out along the center stringers, coating them with glue and tacking as the work progresses.

The first pull should be diagonally across the deck and toward the stem. Later remove the preliminary tacks a few at a



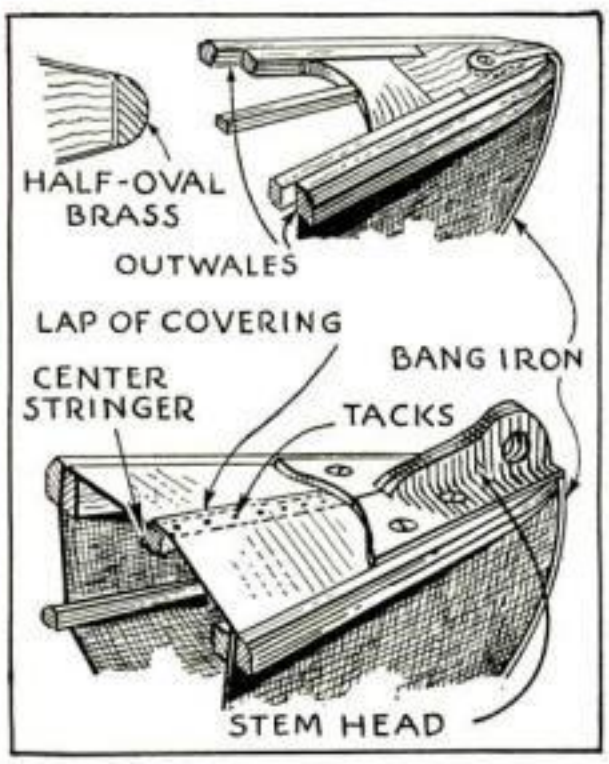
The finished kayak in and out of the water. Although it weighs only 35 lb. and is speedy, it is also very strong

Nov 1932

time and pull straight across the deck at right angles to the center line. The first pull will develop deep diagonal wrinkles running at 45 deg. to the center out toward the wales and back toward the midship section, but a little pulling and close tacking will eliminate most of these, and the few remaining will disappear when the covering has been doped once or twice.

With one half of the deck in place, cut off the excess cloth, spread glue over the stringer, and fasten the opposite side in like manner, finishing off with a sizing of glue all along the center line. Scrape away the varnish around the mast step to provide bare wood for the glue to adhere to.

The hull and deck covering should now have three or four coats of airplane dope, which not only fills the weave of the cloth but shrinks and toughens it as well. Work fast, brushing on the dope much as you



How the half-oval brass bang irons are applied and the stem heads made and fastened

would lacquer. Provide good ventilation, select a moderately warm day, work inside, and beware of matches or any open flame. Allow six hours between coats and sand lightly with No. O paper between coats.

The shoe keel, which was removed before the canvas was applied, is tapered from its full width over the middle 6 ft. to only ½ in. at the joint with the stems, and is screwed finally in place before the enameling begins.

When the last coat of dope has been sanded smooth, apply a coat of good enamel, guaranteed to withstand water and to adhere firmly to the doped surface. Allow ten hours for hardening. Sand this coat until the higher portions of the weave begin to show as whitish dots; then put on the final coat, taking care to avoid runs and the raising of dust. Spread the enamel quickly, much as you would varnish, but work for a thinner coat.

Bang irons of half-oval brass run for a few inches along the keel and a lesser distance beneath the brass stem heads, where they are thinned out considerably to permit the stem head to come down tight. Drill the end of the bang iron and screw it to the deck; then bend it downward at a right angle and fit it to the stem. Drill,

After the canvas has been tacked to the center stringers, rub a liberal application of glue into the cloth along the seam to reënforce it. This takes the place of folding the canvas

countersink slightly, and nail it in place at 3-in. intervals with copper nails, the heads of which have been removed and the deficiency remedied by tapping the end with a ball hammer until expanded enough to fill the small countersunk hollow in the bang iron. The nails should be approximately 1/16 in. in diameter, and ¼ in. of the length will be needed to work into a head.

The stem heads are made of 1/16-in. sheet brass, sawn to shape on a jig saw, or hack sawed and filed. To get a sharp bend without marring the brass, place the blank in a strong vise, with the line along the bend just at the edge of the jaw. Placing the end of a block of hardwood against the protruding section, drive it over with strong blows of a weighty machinist's hammer.

When the matching pieces have been bent, fit the faces tightly by filing away interfering portions. Tin the inner faces with solder and, holding the pieces firmly in place with pliers, heat them over a gas jet or Bunsen burner until the solder runs. Cool quickly and file away the excess solder. Drill and countersink the screw holes.

Little strain will be placed upon these pieces, but it is well to run bolts through the inboard holes of each head, piercing the wales. To accomplish this it is necessary to fit the stem heads before applying the decking. Bore for the bolts, which need be only ⅛ in. in diameter, smear a bit of waterproof cement around the underside of the hole, and turn the nut against it. When the head is removed, the nut will be held by the adhesive, and will still be there after the decking has been stretched in place and the time comes for placing the stem heads.

The king planks are made of ⅛-in. maple. They are cut and fitted before the paint job is started and, as is the case with the outwales, given several coats of varnish and laid away for application after all else has been completed.

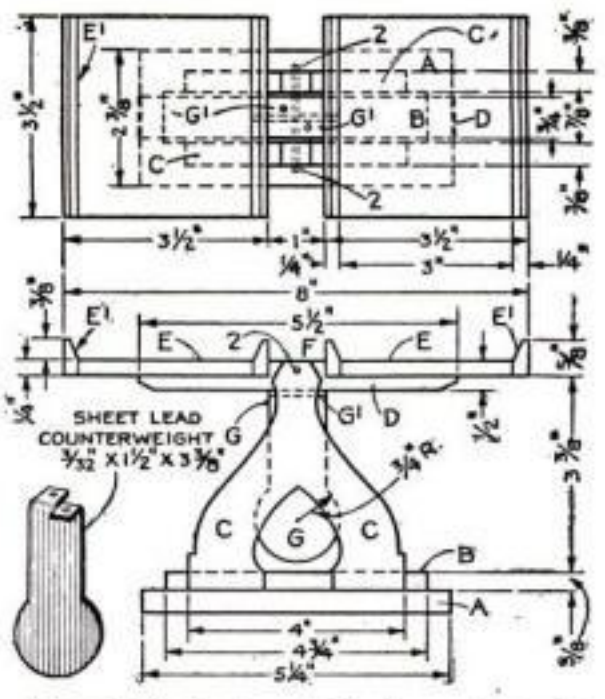
Suggestions for making the spars, sail, leeboard, double-blade paddle, cockpit cover, and cockpit tent will be given next month. All these embody excellent ideas Hazzard has developed in many years' experience. He regards this kayak as the best canoe for one-man, double-blade cruising and for getting about generally.

TOY WEIGHING SCALES MAKE IT MORE FUN TO "PLAY STORE"

CHILDREN find it much more fun to "play store" if they can weigh out the "groceries," "hardware," and other commodities on toy scales that work like the real ones on store counters. Balance scales for this purpose can be made with very little work as shown in the drawings below.

Make the base *A* ⅜ by 2⅜ by 5¼ in., part *B* ⅜ by ⅞ by 4¾ in., and the two supports *C* ⅜ by 4 by 4 in., shaped about as shown. Assemble these parts with glue and brads. Make arm *D* ½ by ¾ by 5½ in., and cut it out to allow the center to be flush with the scale pans *E*, as shown at *F*. Bore the ⅛-in. holes marked *2* accurately through the supports and arm *D*. Then make two pans ¼ by 3 by 3½ in. and four lips E^1 ¼ by ⅝ by 3½ in. Glue and brad these parts together in the manner indicated.

Make the counterweight *G* of sheet lead. Cut down ⅜ or ½ in. on the center line at the top and turn ears down at G^1. Drill holes through the ears and fasten to the underside of *D* in the exact center. For the pivot shaft use a piece of steel wire smaller than the holes *2* so that the pans will respond to the least touch, and balance them either by boring holes, trimming the lead counterweight, or turning in screws to add weight. The pans must be level when at rest.—D. W.

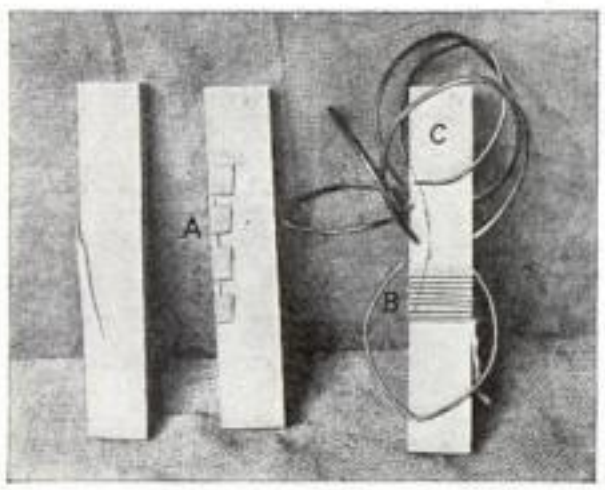


Top and front views of the toy scales and a sketch showing the sheet lead counterweight

Nov 1932

THREE WAYS TO CLAMP SLIVERED WOODWORK

NO MATTER how careful either a home worker or a professional cabinetmaker may be, accidents happen and leave blemishes in conspicuous places. A slivered or a spalled corner may mar an otherwise perfect piece, or there may be a check or shake in the wood itself. Such defects may be remedied easily if no wood is missing. Be sure there are no crossed slivers within the break that will prevent drawing the parts together. Apply glue to the break, draw the sliver to a joint, and stick adhesive paper tape on to hold the



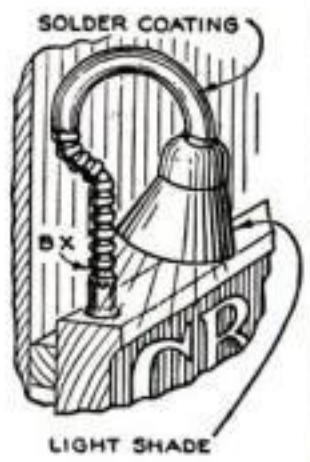
Gluing down a sliver with the aid of gummed tape *(A)*, cord *(B)*, and pointed springs *(C)*

edges, or glue stout paper over the corner and well beyond the break each way as at *A*. After the glue has set, plane or sandpaper the paper away.

If preferred, or if feasible, the break may be glued, pressed together, and held by winding string around the entire piece as at *B*. Another method is to use spring clamps as at *C*. The clamps may be made of stout, discarded upholstery springs or of spring steel wire cut from 6 to 12 in. long, bent as shown and with the ends filed to a point. If placed on the work as suggested, they will hold the sliver until the glue sets. These springs are often utilized by cabinetmakers to hold small pieces in places where hand screws cannot be used conveniently.—DAVID WEBSTER.

MAKING SHARPLY BENT METAL GOOSENECKS

IN ELECTRICAL wiring there are times when a short curved bracket or gooseneck is needed that cannot be bent from the regular solid conduit without kinking. Recently, when it was necessary to make a bracket over a sign for holding a light shade, this problem was solved by using a section of flexible (BX) tubing, which was bent to the proper shape and then soldered along its length. This made a satisfactory and rigid bracket without any kinks in the short bends. Fittings were soldered to the ends for the socket and base.—ARCHIE AMOS.



Light bracket made from flexible tubing

HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*	$ .50
Lindbergh's Monoplane (3-ft. Flying), *69*	.25
Nieuport XVII (29-in. flying), *180-181*	.50
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
S. E. 5a World War Plane (30-in.), *168-169*	.50
Single Stick, Tractor, 30-in., *82*	.25
Tractor (Record Flight 6,024 Ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25
Winnie Mae (4-ft. flying), *141-142-143*	.75

Boats

Canoe, Sailing Outfit, *25*	.25
Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., *192-193-194*	.75
With full size patterns	2.25
Duck Boat, Folding, *170-R*	.50
With full size patterns	2.00
Outboard Racer, 11½-ft., *128-129*	.50
With full size patterns	2.00
Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
With full size patterns	2.50
Marconi Rig with Jib for Above, *133A*	.25
13-ft. Rowboat-Motorboat, *147-R*	.50
With full size patterns	2.00
14½-ft. Rowboat-Motorboat, *148-R*	.50
With full size patterns	2.00
16-ft. Rowboat-Motorboat, *149-R*	.50
With full size patterns	2.00
Stern Drive Installation (When used with Rowboat-Motorboat), *150*	.25
15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177*	.75
With full size patterns	2.25

Furniture

Bookcase, Simple, *37*	.25
Bookshelf and Book Ends, Modernistic, *100*	.25
Bookshelves, Hanging, *77*	.25
Bookstand, Modernistic, *88*	.25
Book Trough, *68*	.25
Cedar Chest, Mahogany Trimmed, *17*	.25
Chair, Rush-Bottom, *36*	.25
Chests, Treasure, *78*	.25
Clock, Grandfather, *19*	.25
Desk, Colonial, *21*	.25
End Table, Magazine, *68*	.25
Fireside Bench, Colonial, *187A, 188A*	.50
Kitchen Table Cabinet, *27*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Muffin Stand, Folding, *173A-174A*	.75
(See page 94 for kit of materials)	
Pier Cabinet and Corner Shelves, *77*	.25
Radio Cabinet, Console, *70-71*	.50
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Sewing Table, *1*	.25
Shelves and Lamp, Modernistic, *93*	.25
Smoking Cabinet, *2*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.) *140*	.25
Tea Wagon, *13*	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube (Battery Operated), *54-55*	.50
Full Electric Headphone Set, *130*	.25
One Tube (Battery Operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50

Ship and Coach Models

Bark, Scenic Half-Model, *108*	.25
*Battleship—U. S. S. *Texas* (3 ft. Hull), *197-198-199-200*	1.00
(See page 94 for kit of materials)	
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper—*Sovereign of the Seas*, *51-52-53-R*	1.00
Constitution ("Old Ironsides"), *57-58-59-R*	1.00
Covered Wagon, *118-119-120-R*	1.00
Destroyer—U. S. S. *Preston* (31½-in. Hull), *125-126-127-R*	1.00
Galleon, Spanish Treasure, *46-47*	.50
(See page 94 for kit of materials)	
Mayflower (17½-in. Hull), *83-84-85-R*	1.00
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Scale Model Driven by Rubber Bands or Toy Outboard Motor (20-in. Hull), *196*	.25
Pirate Galley or Felucca, *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for any Model, *185-186*	.50
Santa Maria (18-in. Hull), *74-75-76-R*	1.00
Schooner—*Bluenose*, *110-111-112-R*	1.00
Sedan Chair, Queen's, *123-124*	.50
Stagecoach, Concord, *115-116-117-R*	1.00
Stagecoach (Cody), Small, with Horses, *144-145-146-R*	1.00
Steamboat, Mississippi, *94-95-96-R*	1.00
Viking Ship, *61-62-R*	.75
Weather Vane, Ship Model, *66*	.25
Whaling Bark *Wanderer*, *151-152-153-154*	1.00
Sails for *Wanderer*, *185-186*	.50
(See page 94 for kit of materials)	
Yacht, *Sea Scout*, 42-in. Racing, *106-107-R*	.75
Yacht, 20-in. Racing, *48-R*	.50

Toys

Airplane Cockpit with Controls, *114*	.25
Birds and Animals, *56*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Drill Press, Woodturning Lathe, Jointer, and Circular Saw, *113*	.25
Dump Truck, Fire Engine, etc., *101*	.25

Miscellaneous

Baby's Crib and Play Pen, *26*	.25
Garage, One-Car, Pergola, *23*	.25
Log Cabin (Three Rooms), *134*	.25
Puzzles, Six Simple Block, *65*	.25
Tool Cabinet, Bench Hook, etc., *30*	.25
Trellises, Garden, *34*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

No..... No..... No..... No.....

Patterns for .....

Reprints alone for .....

I am inclosing.....dollars.....cents.

Name .....

Street .....

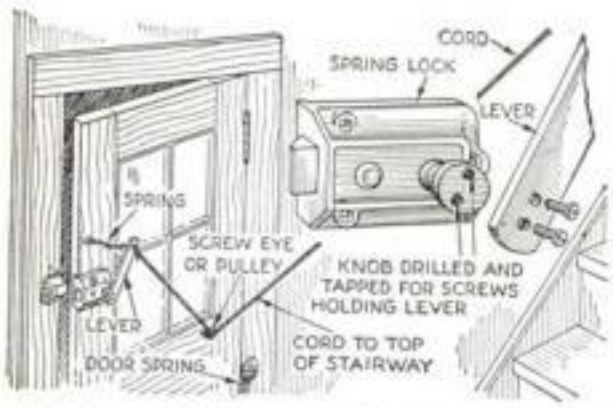
City and State .....

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

PULL ON CORD UNLOCKS DOOR DOWNSTAIRS

IN MANY small houses there are stairs leading from the side entrance up to the kitchen. When someone knocks or rings at the side door, whoever happens to be in the kitchen has to walk down to unlock the door. To save these unnecessary steps, I rigged up a simple device for unlocking the door from the kitchen.

Two holes were drilled into the knob of the night latch on the door, and these



Side door of house with night latch arranged so that it can be unlocked from the kitchen

were tapped to take No. 8/32 machine screws. A metal strip about 6 in. long was then screwed to the knob, and a piece of strong cord (flexible picture wire could also be used) was led from a hole in the outer end of the strip to the kitchen through a pulley fastened to the door as shown and through several screw eyes on the wall.

Pulling the wire unlatches the lock, and the door then can be pushed open. A spring arranged as indicated returns the lever to its original position so that the door will automatically lock itself when closed.—VALENTINE ESPER.

TESTING SOLDERED WORK FOR PINHOLE LEAKS

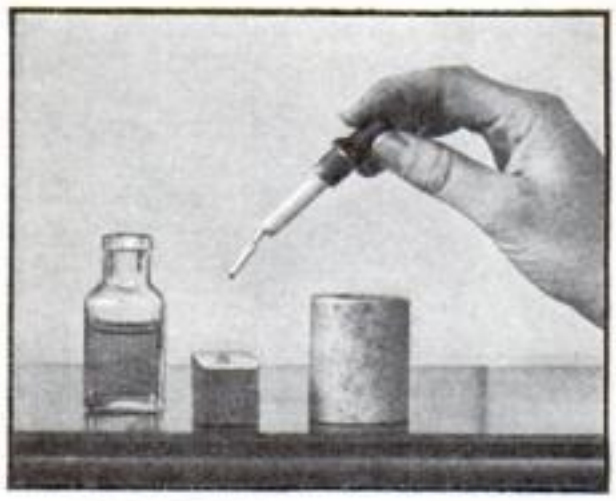
SMALL soldering jobs on gas tanks, pails, kitchen utensils, and similar smooth surfaced articles can be tested quickly and easily with the aid of a large vacuum cup such as used to support clothes hooks. The vacuum cup is slightly dampened and placed over the patch of solder as illustrated. If there is any leakage whatever where the article was soldered, the cup will quickly fall off.—M. G. WINTERTON.

Applying cup *A* to test solder at *B*

Wanted... from Model Railway Fans

short articles, hints, and suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words. Payment will be made upon acceptance for all available material.

EASY WAYS TO IDENTIFY MODERN ALLOYS



TWO TESTS

A drop of strong nitric acid turns brown on plain steel, green on monel and nickel bronze, and shows no change on stainless steel. *At left:* Magnesium alloy remains suspended or sinks very slowly in a sulphuric acid solution

SEVERAL of the more modern alloys are difficult for the shopman and metal stockman to classify correctly. Although they may differ greatly in strength, resistance to corrosion, ductility, and other practical properties, they resemble each other in appearance. However, the more confusing of the metals are easily distinguished by simple tests.

The first thing to do with a piece or section of unrecognized metal is to examine it closely. Rust spots show it to be steel or iron. If it has been protected by paint or grease, clean a spot with gasoline and then brighten it with the flat of a file. Should it be too hard to belong to the lead and tin alloys group, place a small drop of strong nitric acid on the brightened spot. Ordinary steel will give off bubbles of hydrogen, and the drop will turn brown from dissolved iron. Monel and nickel bronze give a green drop. Stainless steel of the cutlery and so-called 18-8 grade will reveal no action at all.

Wipe off the drop of spent acid and test the metal with a strong magnet. Common steel, stainless steel, and monel are attracted to the magnet; but nickel bronze and the similar alloys, German silver and coin nickel, are not.

Two other classes of metal which are likely to be confused are the light aluminum alloys, such as duralumin, and the even lighter magnesium alloys, such as dowmetal. Since the specific gravity of aluminum is 2.7 and that of magnesium is 1.7, the simplest method of positive identification is by a float test. Cut off a small piece of the unknown light metal with a hack saw and drop it into a porcelain cup or glass tumbler containing a solution composed of 15 parts water and 85 parts commercial sulphuric acid, by volume. Be sure that the acid solution is prepared by pouring the acid into the water. This solution has a specific gravity very close to magnesium. An aluminum alloy will quickly sink to the bottom, but a magnesium alloy will remain suspended or sink slowly.—W. G. HAMMOND.

CARBON EXPERIMENTS FOR HOME CHEMISTS

(Continued from page 61)

A small arc lamp can be made by mounting two binding posts of the fahnestock type on small strips of wood six inches long. The outside clips hold the lengths of graphite while the others serve as connections for the leads from the current supply. The two strips of wood are then nailed or screwed to a wood block as indicated in Fig. 4. Being pivoted, they can be moved easily for adjusting the arc.

To operate the lamp, connect the heating device in series with the two carbons as shown in Fig. 4, touch the two carbons by moving their supporting sticks, and turn on the current. The electric appliance will heat up in the usual way and the pencil leads will get hot at their tips. The points are then separated a trifle, causing the carbon to burn in the air with the result that the temperature at the ends is raised and the carbon vaporized. The current now passing through the vapor causes it and the ends of the carbons to glow with a white heat. For a more brilliant arc, the carbon rods taken from discarded flashlight cells can be substituted for the pencil leads. However, when this is done, it will be necessary to alter the resistance of the circuit.

GUS TELLS HOW TO INSPECT STALLED MOTOR

(Continued from page 66)

front seat of the stalled car. A few trys with the starter and the motor ran sweetly.

"By rights," said Gus, "those points ought to last you four or five thousand miles without any attention. If they do go bad before that and your motor begins to act up, you can bet your bottom dollar it's the condenser.

"Finding out what's wrong with a motor that dies suddenly on the road is easy if you'll only remember that two things are needed to run an automobile—gasoline and electricity. Try one, then the other, and its a cinch you'll locate the trouble."

"But, Gus," inquired Joe when the two garage men were again on their way to the railroad station, "that bird's car didn't look more than a year old. How come the condenser burned out so soon?"

"Condensers are funny things," said Gus. "Sometimes they'll last forever and sometimes they'll go on the bum in a couple of weeks. You just can't depend on them. That fellow's condenser was only partly gone, but it was bad enough to burn down the points after a while.

"The tough part of it is, condensers aren't something the average man can fix, so when you're miles from nowhere and haven't a spare one with you, the nearest garage nicks you for the price of a tow. I've carried a spare in every car I've owned. I've never had to use one, but when I do it'll be there—and worth its weight in gold."

HEAT EXPANDS REAMERS THAT CUT UNDERSIZE

MAKING a solid reamer cut oversize by inserting wire of the proper size in one of the flutes is a good emergency kink, but many times it makes the hole larger than required unless there is a great variety of wire on hand from which to choose. Usually this expedient is used because the reamer itself is undersize. It has been the writer's experience that a better remedy in such cases is to reheat the reamer to hardening temperature inside a pipe, quench it quickly, and then temper it. After the process is finished, the reamer should be rehoned. Two reamers which were retrieved in this manner by the writer expanded between .001 and .0015 in. —A. L. EVANS.

Our CONSTRUCTION KITS

Save Time and Money

KIT NO. 4

KIT D

KIT NO. 1

THIS month the Popular Science Homecraft Guild offers an exceptional bargain for ship model makers—a complete construction kit of materials for building a 3 ft. long exhibition model of the U. S. S. *Texas,* flagship of the Atlantic Fleet. The kit contains all the necessary wood, sheet brass, brass wire, brass rods, brass tubing, chains, beads, nails, escutcheon pins, and other materials—in fact, everything but the paints. (If it is desired to install a power plant in the model, the machinery, of course, will have to be obtained separately.)

The price of the kit, sent postpaid to any address east of the Mississippi River, is $6.95. For 50 cents extra, you can also have the five main hull pieces or "lifts" sawed to the correct shape, if you do not wish to draw the necessary patterns and do the work yourself. This new kit is marked *E* in the list below, which gives all the kits now available. Instructions or blueprints accompany each one.

KITS B AND C

KIT A

No. 1. Colonial maple butterfly table with oval top 17 by 22 in., and 22½ in. high. Ready to assemble.....$6.90

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 3A. The same table in solid mahogany. Ready to assemble..... 8.15

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30

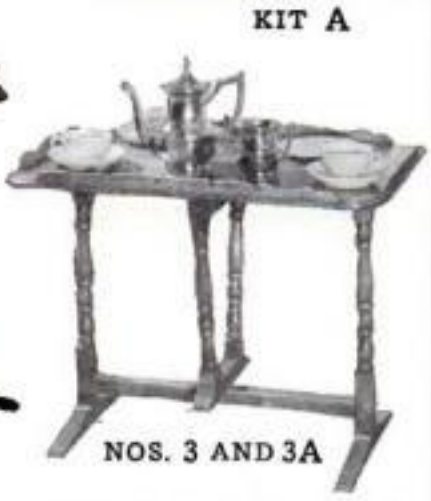
A. Whaling ship model *Wanderer.* All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154..... 6.90

B. Folding muffin stand in selected sugar pine, 11 in. wide, 19 in. long and 33 in. high when open. All the necessary wood cut to approximate sizes but not machined... 2.90

C. Same muffin stand in birch (can be finished as maple, walnut, or mahogany) 2.90

D. Spanish Galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45

NO. 2



NOS. 3 AND 3A

E. Battleship model, U. S. S. *Texas,* 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me the following kit or kits, for which I inclose $..... (or send C. O. D. ☐)

☐ No. 1.	$6.90	☐ A	$6.90
☐ No. 2.	$5.90	☐ B	$2.90
☐ No. 3.	$7.15	☐ C	$2.90
☐ No. 3A.	$8.15	☐ D	$6.45
☐ No. 4.	$5.30	☐ E	$6.95

All prices are 50 cents higher west of the Mississippi River because of heavy shipping charges. This offer is made only to readers in the United States.

Name .....

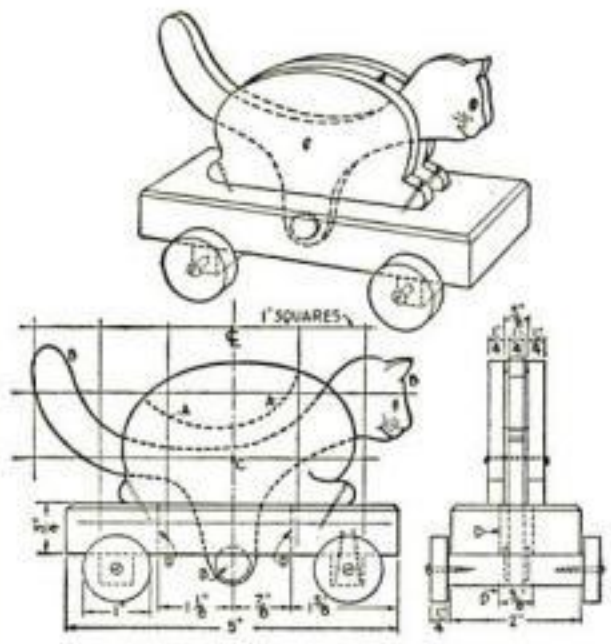
Address .....

City ..... State .....

(Please print name very clearly.)

AMUSING WOODEN KITTY NODS CONTINUALLY

THIS nodding kitty toy may be easily made with the aid of a jig, scroll, or coping saw. Prepare pasteboard patterns of the sides, the back filler piece *A*, and the combined head and tail piece *B* by drawing a series of 1-in. squares and reproducing the curves in their correct relation to the squares. Cut the patterns to these lines, lay them on ¼-in. thick pieces of pine or other easily worked wood, and mark around them. Saw closely to the outside of the lines, making the edges square in all cases. If a motor-driven saw



Side and end views of the toy and a sketch to show at a glance the method of assembly

is used, the two sides may be fastened lightly together and both cut at once, which will insure uniformity.

Mark center *C* accurately on the sidepieces and also on *B*, and drill a ⅛-in. or smaller hole in all three. Assemble the sides and *A* with glue and brads, being sure that holes *C* line up properly. Add two ½-in. disks of lead at the lowest point of *B* to give it more weight.

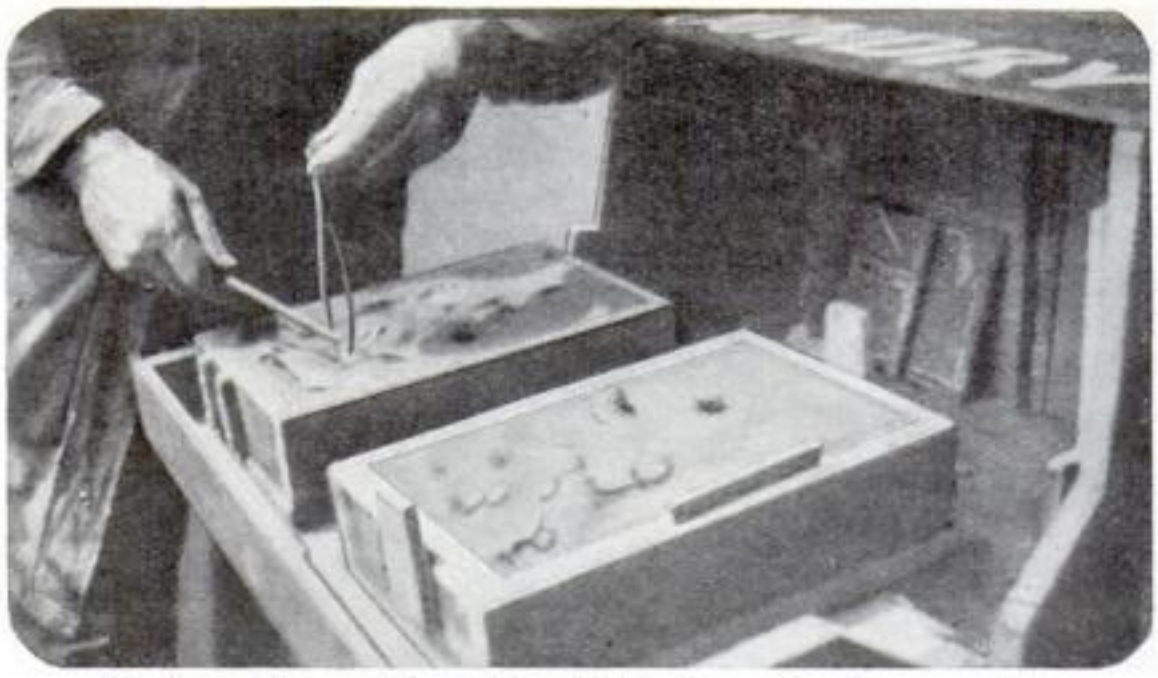
Make the body of the truck ¾ by 2 by 5 in. and cut the rectangular hole *D*, ⅝ by 2 in., through it as shown. Cut two pieces ½ by ½ by 2⅛ in. and fasten them as indicated beneath the body with glue and brads. Make wheels of 1 in. diameter wood, drill 3/16-in. holes through the centers, and fasten them loosely with ¾-in. No. 8 screws.

Assemble kitty by pushing a piece of wire or a slender cotter pin through holes *C;* place her so the center lines coincide with those of the truck and fasten the sidepieces to the truck with glue and brads. Paint the cat as desired and decorate the truck with gay colors.—C. K.

ADAPTING LARGE CORKS TO SMALL BOTTLES

AN oversize cork may be reduced in size by rolling it under a heavy weight or shaving it down under water, but an easier method is to cut one or two wedges from the smaller end as shown.—W. L. F.

Fitting a big cork



Drawing a pattern gently out of a mold after the cope has been rammed up

Molding Equipment

for Making Small Castings at Home

BY JOSEPH C. GILBERT

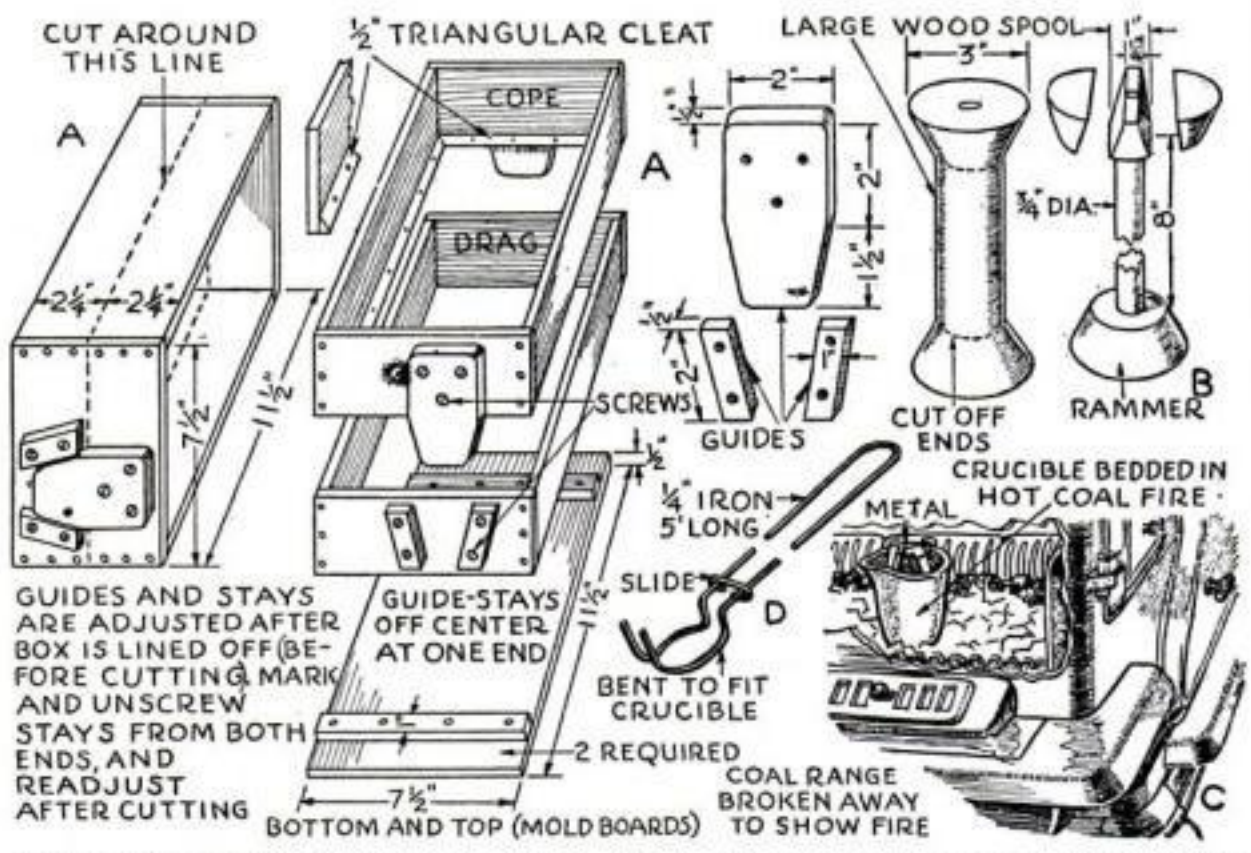
EQUIPMENT for making small castings from lead, type metal, aluminum, and other nonferrous metals can be prepared so easily and at such low cost that there is no reason why the model maker or experimenter cannot do his own foundry work at home.

First of all, of course, you will need some sort of box or cabinet to hold your outfit and a small sand bin. These were described in a previous article (P.S.M., Oct. '32, p. 93). The molding equipment proper consists of the following:

A flask or box made of ½-in. stock as shown at *A* in the drawings. Fasten guide blocks and stays at each end with screws. Have one set of these off center so that the flask can be closed only one way. Nail a ½-in. triangular cleat along the inside joint edge of the cope or top member to retain the sand.

A small scoop of the ten-cent variety and a 10-qt. pail full of fine molding sand, obtained from a local foundry supply store or foundry. If you get it from an iron foundry, ask for new, fine bench sand. Do not take the black or used kind from an iron foundry. On the other hand, if the sand is obtained from a brass foundry, the used kind with one-quarter of the amount of new sand mixed with it makes the best sand for molding. *Do not* use French sand from a bronze foundry; get the architectural or red sand.

Parting sand. A good handful of sea coal (crushed charcoal dust) or coarse



Equipment needed for foundry work at home. The flask is made as a unit, and the guides and stays are screwed on; then the stays are removed from both ends until the box has been cut in two

gravel or bank sand may be burnt on the stove, cooled, and sifted through a fine sieve. Place it in a discarded stocking and tie up both ends. This makes a dusting bag for shaking the parting sand on the joint surface of a rammed up drag (lower part of the flask).

A rammer made as shown at *B*.

A vent wire, which may be a knitting needle or a bicycle spoke.

Draw nails—a 3-in. darning needle for small patterns, and a piece of ⅛ in. diameter iron rod 8 in. long, drawn to a long, sharp point at one end.

A rapping bar. This may be of ⅜ in. diameter iron rod 8 in. long.

A swab of the ten-cent kind about ⅜ in. round to brush a little water around the patterns before rapping to draw them.

Making a clean joint around a pattern in the drag before the upper part or cope is added

A punch sprue—a piece of brass tubing ⅝ or ¾ in. diameter and 6 in. long.

A gate cutter. An ordinary old teaspoon may do, but the regular molder's heart-and-spoon slicker, medium size, is much better.

A strike. This may be a discarded 12-in. ruler. It is used to strike off or scrape away surplus butted sand even with the top of either the drag or the cope so boards may be rubbed on evenly.

A sand sifter made from the cover of a corn popper or something similar, nailed to a small box

Two small clamps made from ¼ in. diameter iron, bent at both ends to form 1-in. "toes." These should be of a size to fit the flask and top and bottom mold boards when assembled, but there should be a little leeway to allow small wooden wedges to be inserted under the toes for tightening the grip of the clamps.

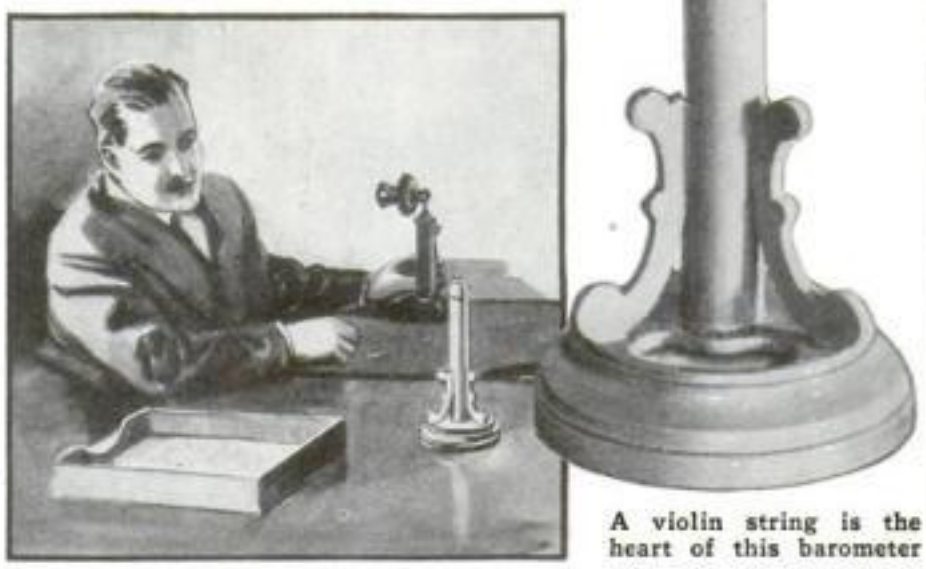
Casting equipment. A 3 by 5 in. crucible (shown at *C*) is, as a rule, large enough. A 3- or 4-in. plumber's iron ladle is desirable for lead melting.

One pair of tongs *D* made of ¼-in. iron from 4½ to 5 ft. long. Also an ordinary small stove poker to skim off the dross.

The heats may be taken from a freshly made coal or coke fire built in either the kitchen range, a laundry stove, or the furnace.

In an article to follow, Mr. Gilbert will tell how to make small castings.

Desk Ornament Predicts Weather



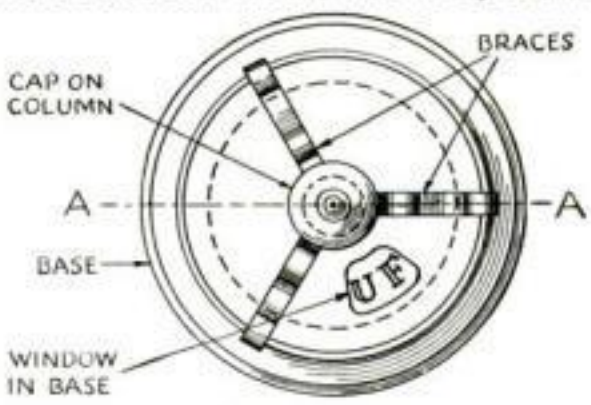
A violin string is the heart of this barometer

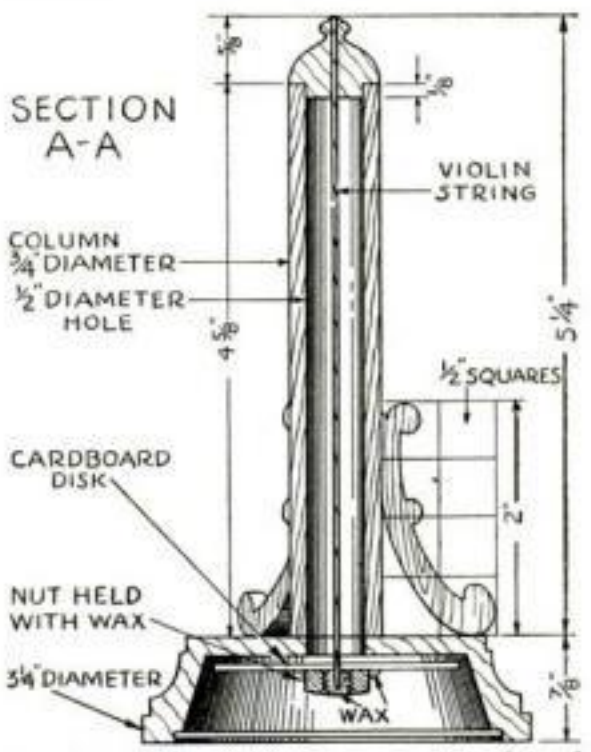
THE heart of this little desk or table barometer is a violin string, which, twisting and untwisting according to the dampness of the air, turns an indicating dial. The materials can be obtained for a few cents.

To make the base, screw a piece of 1 by 4 by 4 in. hardwood to a faceplate, turn it to diameter, and surface it. After turning the molded edge and the ½-in. center hole, sand the piece smooth.

Remove the base from the faceplate, substitute a larger block of wood, and recess the front to receive the base snugly. Insert the latter bottom side out so that it projects about 1/16 in. Hollow it as shown and turn the shoulder to take the cardboard bottom. Remove and cut the "window" through which the weather indications are to be read.

Make the column from a square piece of hardwood, boring it in the lathe with a ½-in. bit. While still on the bit, lash one end to the drill chuck with wire, mount the faceplate with its wooden chuck on the tailstock, and force the point of the bit into the chuck to steady it. After this has been done, the outside of the column can be turned. Turn a cap to fit.





The base, column, and cap are turned, and the ornamental brackets cut on a jig saw

Three brackets, to be set around the column at 120-deg. intervals, are laid out on cardboard by sketching the outline through ½-in. squares. Tack the pattern and three thicknesses of stock together with brads and saw out on a jig saw. Sand smooth and glue them and the column to the base. Finish the case with lacquer, enamel, or varnish before installing the mechanism.

Cut a piece of violin string 8 in. long. Thread one end through the center of a heavy cardboard disk, securing it on the underside with melted sealing wax. Press into the wax a ¼-in. nut or other weight to hold the string straight. Thread the other end of the string through the column and a small hole bored in the cap, where it is glued when the disk hangs 1/16 in. below the inside of the base top. To increase the circulation of air in the column, drill a small hole in the top near the cap.

Instead of waiting for the weather to change to get the calibrations on the dial, soak the inside of a cardboard box with water and set it over the barometer for a couple of hours, rewetting it occasionally. Then mark an "S" on the disk in the center of the window for stormy. Now stand the gadget on a warm oven, or in bright sunshine if the day is dry and warm, and let the dial shift as far as it will. Mark the new point "F" for fair. Midway between put a "U" for unsettled. These markings can be inked in as elaborately as desired.—EDWIN M. LOVE.

FILLING HOLES IN WOOD

WHEN it is desired to force a plastic wood composition or wood putty into a hole and let it dry under pressure, put a piece of waxed paper between the work and the block before clamping. The waxed paper not only will peel without dragging out the plastic material, but also will not absorb the moisture from the surface, causing it to dry too rapidly.—C.M.B.

FAN WHITTLING STUNTS

(Continued from page 75)

bird or a flying fish with wings and tail formed as fans. The tails and wings will be in reality the same fan, the division being attained by bending one blade each way alternately instead of forming them as a single spread. This requires a well-soaked piece and careful splitting to the notch.

If more complicated applications of fan whittling are desired, Fig. 4 provides an idea —a bird in a cage with fan wings and a tail on the bird. This is my own adaptation of the ball-in-a-cage stunt. The method of forming the fans is shown in the drawings at *F*. Bird, wings, tail, and cage are, of course, all whittled from the same piece.

Fig. 3. A double fan in a bottle

The little lady of 1860 or thereabouts, complete as to skirt, overskirt, flounces, tip-tilted hat, and bouquet, is likewise of one piece of wood. The left-hand photograph in Fig. 1 shows her before the cleaning up process incidental to finishing. If desired, she might be colored with oils. Details of her construction are shown in the drawings at *G*. The important thing to remember is that fragile or unsupported sections should not be completed until all rough cutting has been done. Thus the fan in the lady's hand should be whittled out just before the blades are split. Since the grain of the wood runs across her body, great care must be exercised that her head or arm is not broken off.

It is essential that the notches for the skirt fans be brought as close together as possible in order that they may present an unbroken skirt line at each side. It must be remembered, however, that bringing them too closely together will cause the stem to break off when the blades are split, or possibly may cause the stem to be split across as the leaves or blades are separated. This fan also differs from all previous ones in that the blades, when brought to place and strung together, are bowed downward and pulled in to form the skirt. This must be done carefully while the piece is very wet.

Fig. 4. Bird and cage in one piece

Similar projects might include a Christmas tree, a floor lamp, an umbrella, an Indian chief and his headdress, a ballet dancer, a Hawaiian belle, perhaps even a Liberty Bell, and so on. Another fan project that offers considerable fun is the fan in a bottle shown in Fig. 3. This is produced by taking a piece of wood small enough to enter the bottle neck, forming the fan completely, stringing it, then folding it just as a lady's fan is folded and inserting it through the neck into the bottle. It is reopened with long wires and held until it dries. The second little fan below is just an added complication.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

"SECRETS of Success" is a new department inaugurated for the purpose of answering an ever-growing question: "How can I get ahead?" This question is on the lips of millions of young men in this country. It has come from men about to enter the business world and looking for vocations that suit them. It has come from young men who know what they want, but don't know how to gain their objective. It is on the lips of men using their present jobs to supply a livelihood, while they wonder how to fit themselves for the type of work they really want to do.

Each month this department will print stories of men who rose above all obstacles to follow the work they believed would bring them greatest happiness and success. In these miniature biographies many a young man, seeking the inspiration for his own hopes, may find the way that will lead him to the same goal.

• •

HOW AMERICAN WAR ACE BEAT HIS HANDICAPS

AS A perfect example of a man who set his goal and gained it, read this life story of Eddie Rickenbacker, famous American war ace. It is a tribute to the power of concentration of this man, and of his ability to make worth-while use of every minute of his spare time.

The child of poor parents, he launched upon his "spare-time" career as a little boy, selling papers on the streets of Columbus, Ohio. He served as an apprentice in his father's marble cutting shop, and when his father died, young Eddie Rickenbacker, in his spare time, cut the stone for the grave.

Two things contrived to change the direction of his career at that time. One was the fact that his delicate health and frail body could not endure the dust laden air of the stone cutting shop, and the other was the budding of a new industry—the automobile. Eddie Rickenbacker had the vision to see that here was an industry that would pay tremendous dividends in the future. When his mother, fearing consumption, took the boy out of the stone cutting shop he continued to be the family mainstay, although now he was concentrating on the many problems that confronted an automobile shop in those days.

Things began to happen. Automobiles took on a more pleasing aspect to the eye. The old high-slung monsters were disappearing. Engineers were hard at work trying to get beyond the old one and two "lunger" engines. *(Continued on page 102)*

"SURE, I CAN DO 'MOST ANYTHING-"

but it's the *TRAINED MAN* who's hired these days

Thousands of untrained, unskilled men—"Jacks-of-all-trades" and masters of none—were taught a bitter lesson by the Depression. They saw themselves ousted from their small jobs FIRST, while the highly-trained men were kept on. Now, with the country returning to normal, they see themselves still jobless while trained men are back at work. What's the answer? Get training! Get it N-O-W! There is still time to train for a well-paid, interesting trade and qualify for one of the many jobs opening up in electricity. **And it's easier than you imagine, too!**

Don't be a "Jack-of-all-Trades" *master* ELECTRICITY

in 90 Days Through Practical Coyne Training!

These Training Shops Fit You for Real Jobs—Big Pay—and a Real Future in the New, After-depression World.

Work in the A. C. Department at Coyne teaches every phase of this branch of Electricity.

In the Refrigeration Department at Coyne you work with actual latest models of all makes of Electrical Refrigerators.

In the Construction Department at Coyne students actually build and install electrical equipment of all kinds.

Not tedious book study—not a lot of unnecessary theory—but actual work RIGHT HERE IN THE COYNE SHOPS IN CHICAGO. It makes no difference if you have had no experience, or if your education is limited. Our amazing way of teaching makes it easy for you to learn quickly and well. You get right into building real batteries, winding armatures, operating real motors, dynamos and generators, wiring houses, doing conduit work, wiring giant electric signs, working on big telephone switchboards, electric refrigerators, air conditioning equipment, working on latest model auto and airplane motors, etc. In fact, you actually do all the things you will be called upon to do as a master electrician. It is so interesting and comes to you so easily and naturally that you are a trained man almost before you realize that you have been learning. Every phase of the great Electrical Industry may be learned here to fit you for a career in this gigantic field. Stop and think—practically every industry today is connected with Electricity, and you can easily realize that, as a Coyne-trained Electrician, you will be in the best position to profit from Prosperity's return to America.

Many Earn Living Expenses—We Help You!

Don't let a shortage of cash keep you from coming to Coyne for your Electrical training. We maintain an active department especially to help you find spare-time employment. Many Coyne students earn all or part of their living expenses while here. We'll help you, too. Determine RIGHT NOW to get training and make a success of life. NOW is the time—we'll gladly help you—send the Coupon TODAY!

Get This FREE BOOK of FACTS

Learn all about the Big COYNE SHOPS. This big, free book is illustrated with hundreds of photos. It will tell you all about jobs—salaries—opportunities for trained Electricians. It describes the Coyne system of learning by doing—the Lifetime Free Employment Service for Coyne-trained men. It is more fascinating than fiction—and it's crammed full of thrilling facts that PROVE you can cash in on Coyne training just as thousands of other successful men have done. If you want to make yourself one of those fortunate men who are "first" to be hired and last to be "fired" send for this big book RIGHT NOW. Mail the Coupon TODAY!

COYNE ELECTRICAL SCHOOL
H. C. LEWIS *President* FOUNDED 1899
500 S. Paulina St. DEPT. 82-73 Chicago, Ill.

H. C. Lewis, President,
COYNE Electrical School, Dept. 82-73
500 S. Paulina St., Chicago, Ill.

Dear Mr. Lewis: Send me your big, interesting book about Coyne training without any obligation to me, and explain more fully why Trained Men are better off now that Depression is nearing its end.

Name.....

Address.....

City.....State.....

Secrets of Success

HOW AMERICAN WAR ACE BEAT HIS HANDICAPS

(Continued from page 100)

Rickenbacker was growing up in a changing world of automobiles and he charged into the expanding industry with characteristic vigor. His days were consumed in work that brought out the best in his head and hands. But his nights were free—and this spare time he devoted to the study of engineering principles. At twenty he had the title of experimental engineer.

The next six years were devoted to gathering an ever widening experience in the automobile world. He started out as a racing driver and won many national and international trophies. He went out to sell cars—and did. With the practical knowledge thus gained, he called upon his inventive talents and became the designer and manufacturer of a low priced car.

Then came the War. Eddie Rickenbacker accompanied General Pershing to France as a member of his automotive staff, but at his own request was soon transferred to the Air Service. He was a member of the famous 94th Aero Pursuit Squadron and finished the War with twenty-six victories—the finest record of any American aviator. Today he is vice-president in charge of sales for the Fokker Aircraft Company, a General Motors unit.

In the story of this man, one thing is evident. It could be almost any one's story—that is, the story of any one with a definite goal and definite determination to reach that goal. Essentially it is the story of a man who was willing to concentrate every effort, every spare minute to gain his goal.

WILLIAM RILY COPPAGE USED HIS SPARE TIME

UNTIL he was eighteen years old, William Rily Coppage had never been further from Lebanon Junction, Kentucky, than Tallapoosa, Georgia. Today Rily is one of the best known names in the construction game.

As a youngster, Coppage could read and write and figure a bit, but his main asset was his broad, strong back. That six foot one frame of his was "rarin'" to go. His father's farm was too small to hold him, and out into the world he went. His first job was with the Southern Railroad. There, until he was twenty-one, Rily helped build wooden bridges along Dixie's rights of way. The gang lived in box cars; cooked meals at camp fires in timber or swamp edge—and *worked*. Muscle was all that Rily got out of that life. He grew discontented. He wanted something more.

His next job was an apprenticeship with a Philadelphia bridge company, and here he found his life's work. Thereafter he followed steel. The trail led to field jobs for railroads, bridge and ship builders and general contractors all over the country. He could handle men, as his various employers soon *(Continued on page 103)*

Secrets of Success

WILLIAM RILY COPPAGE USED HIS SPARE TIME

(Continued from page 102)

found out. At forty, Rily found himself an assistant foreman. This was the critical point, the point beyond which most men never go. "Well," Rily reflected, "I can *take* orders okay but if I'm ever going to get anywhere, I've got to learn to give 'em!"

The larger the construction, the more important become the tiniest fractions. At forty, Rily began to study mathematics. He studied at school, in boarding houses, on trains, and in hours when the other members of the gang were sleeping. Later, he studied advance constructions methods. He is studying yet.

That preparation brought its rewards, though Rily never dreamed how high it was to lead him. Up the ladder he went. Foreman, assistant superintendent, superintendent, general superintendent of some of the greatest construction jobs. Such is his record for the last twenty years.

He was foreman in the building of the Manhattan Bridge over the East River, in New York City, and he superintended the lowering of an elevated railroad line to go under that bridge. He bossed the erection of the famous Grand Central Palace in New York. Now, at sixty, he has just completed his biggest job as superintendent in charge of the installation of wire work and anchorage on the George Washington Bridge—world's largest suspension bridge—spanning the Hudson at 180th Street, New York City.

William Rily Coppage had no "breaks." He worked as hard as a man could, and he studied even harder, for his goal.

Cash Prizes

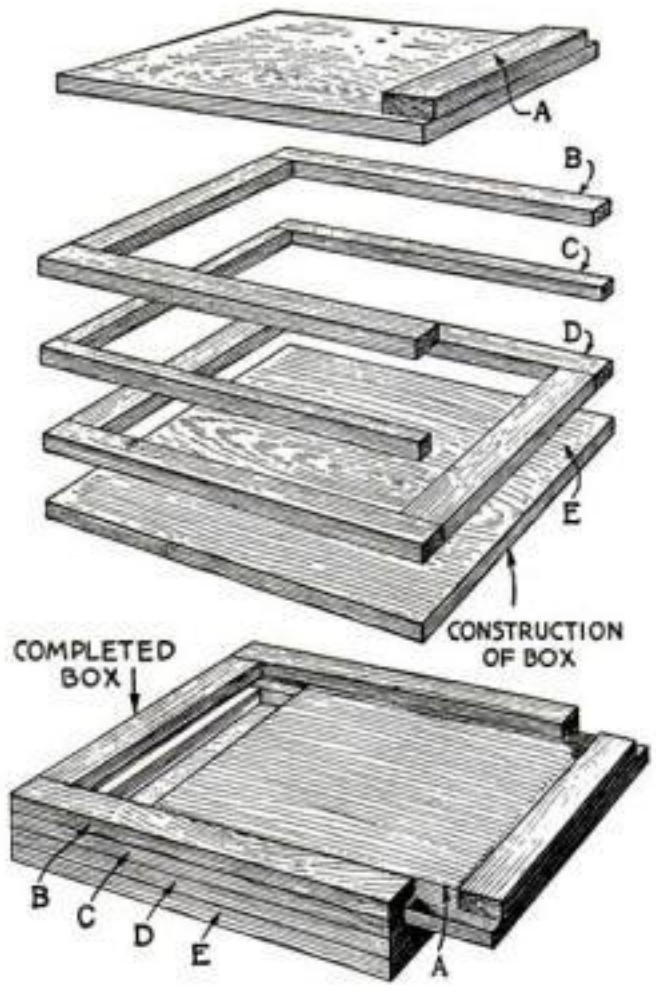
Awarded For All True Success Stories Accepted and Printed

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

CUT-OUT PUZZLE HAS TRICKY SOLUTION



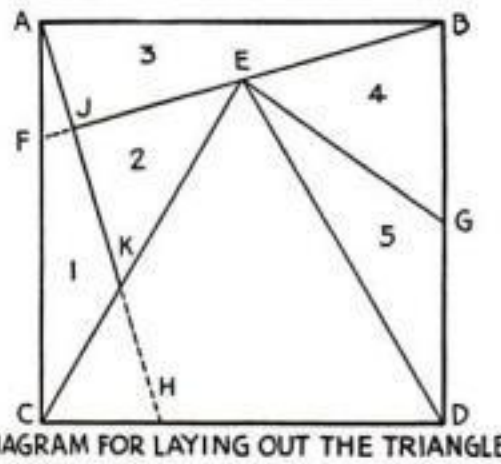
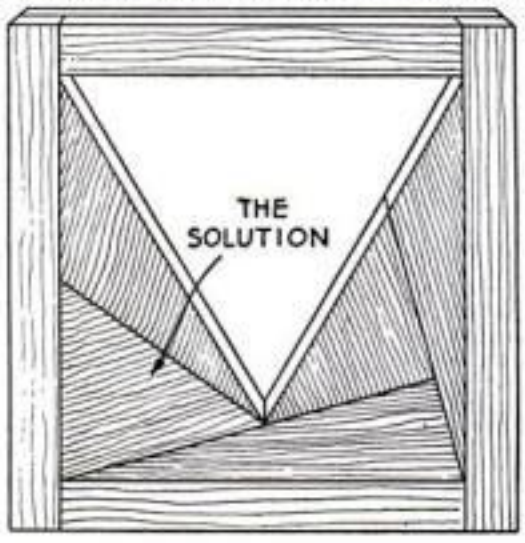


DIAGRAM FOR LAYING OUT THE TRIANGLES



This puzzle, devised for *Popular Science Monthly* readers by one of the foremost experts, is deceptively simple. Five pieces have to be arranged to form an equilateral triangle

AN UNUSUAL cut-out puzzle with a "catch" in it may be made from cigar-box material as shown in the drawings above.

The problem is to form an equilateral triangle in a square box or frame by using five pieces of the shapes indicated. The solution depends upon the fact that the triangle is formed by the space left when the pieces are correctly assembled. Anyone with an instinct for solving puzzles is likely to suspect this trick, but even then it is rather troublesome to assemble the pieces.

Either a frame should be made to hold the pieces, or a box. An easy way to make a box with a sliding cover is illustrated. The base *E* is 5 in. square; frame *D* is made of strips ½ in. wide glued to *E;* frame *C* consists of three strips ¼ in. wide glued to *D;* and frame *B* is made of strips ½ in. wide. The sliding cover *A* is 4¾ by 4½ in., and the strip glued to the top is ½ by 4 in. The inside bottom of the box may be painted white or some other color, and the outside parts sandpapered, stained, and waxed.

Five triangles are cut out of material the same thickness or slightly thinner than that of frame *D*. The diagram shows how they are laid out. Draw a 4-in. square accurately on cardboard. The equilateral triangle *CED* is erected on the base. Through points *B* and *E* the line *BJ* is drawn. *AF* is found by prolonging *BJ* to *F*. *CH* equals *AF*. Line *AK* is drawn from points *A* and *H*. This makes the triangles *2* and *3* right angled. It is a little more confusing to assemble the parts if they are so. *EG* is drawn to the middle point of *BD*.

Using *1, 2, 3, 4,* and *5* as templates, cut out the wood parts and sandpaper, stain, and wax them.—ARTHUR L. SMITH.

NOVELTIES MADE FROM PHONOGRAPH RECORDS

OLD phonograph records can be converted easily into novel wall pockets, card trays, paper clip holders, and small receptacles for various purposes. Place the record in a large pan of boiling hot water and let it soak for a few seconds. It will become soft and limber enough to be shaped with the hands. The shaping must be done immediately upon removing the record from the water, and it will be necessary to immerse it several times during the process to keep it sufficiently soft and pliable.

Phonograph records modeled into odd shapes

After the record has been shaped, it may be decorated to suit the fancy, but it is best to leave the label frankly in the center and apply any ornamentation around the edges. Not all records will respond to this treatment, but the majority can be softened.—PAUL HADLEY.

SPOT CROOKS BY THEIR EARS

(Continued from page 17)

However, a detailed comparison of the ear on the unknown corpse with Foster's ear, as shown in rogues' gallery side views, proved the dead man was not the wanted gangster and the hunt for him continued.

At various times, such comparisons have played a part in solving crimes and sporadic investigations of the ear as a means of identification have been carried on in different parts of the world by criminologists. But, no one had thoroughly explored the possibilities of the subject until Dr. Kilmer began his decade-long research. And, the most sensational phase of his work remains yet to be described!

A little more than a year ago, he was running over pictures in a rogues' gallery when he was struck by a surprising thing: the large number of protruding flap ears. Taking out a pencil, he tallied up the number of flap and close ears with little marks on a sheet of paper. The flap ears reached such an unexpected total that he called the fact to the attention of an officer.

"How do you know there aren't just as many flap ears among honest people?" was his comeback.

"That's just what I intend to find out!"

TO DO this, the doctor obtained permission to go over hundreds of passport and other identification photos of men well-known for character and honesty. He selected approximately the same number of honest pictures as there were criminals represented in the rogues' gallery. When he finished his flap ear census, he added up the totals and found that twenty-three percent of the honest persons had such ears, while among criminals of all classes the average was forty-four percent, a ratio of practically two to one!

Striking as this fact was, it was infinitely less amazing than the result of the next step in his investigation.

Going back to headquarters, he again went over the pictures of the known, hardened criminals, dividing them into groups according to the crimes for which they had been sentenced. Then, he worked out the percentage of flap ears among auto thieves, stick-up men, burglars, jewelry thieves, kidnapers, forgers and swindlers.

Nearly sixty-four percent of the auto thieves had flap ears; more than fifty percent of the stick-up men; approximately forty-eight percent of the burglars, and more than forty-five percent of the jewelry thieves. At the bottom of the list were the forgers, with about twenty-five percent, and the swindlers, with only sixteen percent.

Why do people have flap ears and why is the thief more likely to have them than the swindler or the forger?

DR. KILMER has a theory growing out of his years of medical practice during which he treated babies in the tenements and babies in the homes of millionaires. Children given the least attention, he noted, were most likely to develop protruding ears because they oftenest slept on them while folded over. The life history of criminals almost invariably shows they also were neglected in childhood. There is a definite link, Dr. Kilmer suggests, between crime and flap ears. The same environment that breeds the former produces the latter.

During the next few years, Dr. Kilmer intends to carry his unique researches still further. The results will be watched with keen interest by officials all over the country. One of the next important steps in criminology may be the application of the findings of this doctor to the science of catching crooks.

STARTLING STUNTS WITH TOY PLANES

(Continued from page 19)

Illusion? Yes. But it is more. Here you have the ultimate in thrill-making for the talkies. It is not trickery, however, for by this means the cameraman records scenes impossible to film out doors because of great danger to the actors. A couple of days later, I sat in a tiny projection room viewing the "rushes." On the screen flashed scenes showing the large ship of which the miniature was a counterpart, roll slowly up to a hangar. Passengers disembarked, laughing at near death in the air. Those scenes were made with a large plane having an eighty-foot wingspread.

Then I saw other scenes of the miniature, including one showing only the three engines and the main body of the ship as it passed overhead. It gave a distinct illusion of size, yet the picture filling the screen was made with the little plane whose operation I have described.

To film these scenes, including the super-thriller of a plane hurtling down through the sky to crash through a hangar roof, Fulton moves his camera very close to the "airport." For added realism he places in the foreground a tiny hangar, possibly an airway beacon, and tiny wooden figures. Then the "pilot," rolling the stick and pulling a rope, guides the little ship quickly downward and sends it unerringly through the roof.

ELECTRICITY and powder blow up the tiny plane as it touches the hangar. At that instant, a circuit is closed and three "squibbs" explode, releasing three wires running to the two wings and the tail. These, in turn, release the fifteen wires carrying the plane, leaving the ship free to fall and tumble through the paper roof. At the same time a bomb is set off. This ignites fuses of three different lengths. Number one is connected with the main gas tank, a tiny zinc container partly filled with half-pint of gasoline. Five seconds later the second fuse explodes with the tank hidden in the center section. And five seconds later the longest fuse burns to the end and up goes the wing tank in a burst of flame and débris.

Burning gasoline scatters its fiery trail across the hangar and for a minute or longer, the camera, running very fast in order to accentuate the explosions, blinks at this devastating crash.

Some of these scenes are recorded as though the sun were blazing down on the desert. Then it becomes necessary to put in the background, shot several days before. Meantime, to make sure no extraneous scenery moves in to spoil the effect, these miniature shots are made with all the apparatus—camera, planes, properties—surrounded by a heavy, black curtain.

BUT there are other sequences to be filmed. An air picture always calls for a fight, possibly between pilot and passenger, high above broken clouds or among towering, rocky peaks. But the conflict occurs in the quiet of a sound stage, not two miles above the earth. A puppet plane provides the means. Synchronized motors, running in a projection machine at one end of the stage and in the camera at the other, make this possible.

The action really began several weeks before when Fulton took his camera and flew to Bishop, at the base of the high Sierras in California. Four hours daily for a week, he flew at altitudes varying from 12,000 to 14,000 feet, dashing through bumpy air up canyons, skimming along the crests of knife-like ridges, plunging through cloud formations. During this time he ground out thousands of feet of "scenery."

When he had developed the negatives and selected those that would provide the best backgrounds, action on the sound stage started. Again I sat behind his camera one quiet night to view the "processing," as it is known.

In the foreground were his camera and an airplane in whose open cockpits the players sat. His camera pointed through the wings past the actors directly at the screen. This consists of a single piece of sand-blasted plate glass at the opposite end of the room, some 200 feet distant. Sun arcs cast their brilliant rays on the plane and principals, but the camera-side of the screen remains dark, for the clouds and mountains were to become part of this close-up and any stray light would have washed them out.

AGAIN we were ready for action. A buzzer rang.

"We're in 'sinc'," Fulton said to John Ford, the director.

"Okey," Ford replied. "Start the wind machines. Move that mike in closer. All quiet. Shoot."

The picture appeared on the screen. One actor climbed out of the forward cockpit. The plane swayed on its cable as a carpenter pulled the right wing down. And the camera recorded the double scene, exposing each frame at the precise instant the projector exposed a frame of clouds on the screen. And there we had a conflict over the Sierras, made to order on the stage.

After a few minutes the plane's position was shifted. Now it pointed directly at the screen, the camera located a few feet behind its tail. A few preliminary scenes were run off on the screen. They revealed, from the cockpit through the wings, people running and buildings coming up to meet the ship as it dove and rolled around in the air. But the comedy had not been filmed.

The plane was moved into position to blank out the ship shown on the screen. Now all we could see were the changing sizes of scurrying figures, the shifting pattern of fields and hangars. We were ready to dive again at that airport, safe on the floor of the sound stage.

Noise, crash, tearing of fabric, shouts—and a realistic landing with a plane that had been at all times under absolute control. Three cameras later told the story.

THESE ships can be made to fly with broken wings, lost ailerons, ripping fabric. In fact, any condition desired can be reproduced by these puppets and made to appear as thrilling as though it actually had happened two miles above the earth. But they're not "fakes." They are necessary methods of achieving effects without endangering the lives of actors, pilots, and technical crews.

The script called for a pilot to fly his biplane after the entire lower right wing had been torn away in the air. He could not avoid crashing, possibly with death as his reward. So before the ground glass, they went to record the air scenes. Now for the crash.

At a nearby airport studio, carpenters constructed a framework forty feet high. At one end they built a short runway, tilted at an angle. With block and tackle they hoisted in place a dummy plane, constructed at little cost. Then, with cameras pointed at a chalk-outlined circle, the ever-present assistant tripped a latch, the plane slid down the wooden planks and kerplopped at the appointed place, faithful within a foot in keeping its appointed rendezvous with celluloid and the movie audiences.

Yes, the puppet planes provide the talkies' greatest air thrills.

FIGHTING THE SEA FOR WRECKED SHIPS

(Continued from page 53)

cut through the bulkheads with the then newly invented oxy-electric torch.

This torch differed from the ordinary electric torch in that the arc burned in a powerful jet of oxygen, supplied from cylinders. The terrific heat caused by the current produced a protecting bubble of steam around the flame; from the glare of which, even in the thick muddy darkness, they were compelled to protect their eyes. The torch worked perfectly—cutting steel plating, half an inch thick and buried under icy water, like wax.

After holes had been cut through the bulkheads, twenty-one giant legs, built of thirty-foot steel girders, were erected on the side of the ship. Beside the next pier were sunk twenty-one great concrete blocks. Then steel rigging was strung from the legs to tackle on the blocks and to twenty-one steam winches. For a week they tugged away slowly. Pumps capable of handling more than a million gallons an hour began throwing out water. Finally the *St. Paul* floated.

The most southerly base of the Black Horse fleet on the Pacific coast is at San Pedro, Calif. But from there was quickly sent the crack salvage ship *Peacock*, to the aid of the *S. S. Steelmaker*, grounded on the rocks off Nuokulailai Island, 700 miles south of the Equator.

UPON arriving, salvage engineers determined that the *Steelmaker* would have to be removed from her dangerous position on the rocks before she could be repaired. Pumping the water from her holds with a battery of submerged pumps, and taking advantage of the lift of the tide, she was worked clear of the reef. Still pumping, against the inrush of water through twenty-seven gaping holes in her side, the damaged ship was towed 700 miles north to the calm harbor of Pago-Pago, Samoa.

There, three divers from the *Peacock* measured the holes, applied wooden forms constructed on the salvage ship to their specifications, and tamped in these forms with concrete lowered in canvas bags. After overhauling the engines, the *Steelmaker* was navigated by salvage officers, under her own steam, to a dry dock in New York. In making the return trip to this rescue, the *Peacock* had sailed 9,727 miles—the longest salvage trip on record.

Occasionally comes that most romantic task of all, the reaching down in the sea for sunken treasure. Only last fall the *Peacock* figured in the beginning of what turned out to be one of the most successful treasure hunts attempted in American waters.

WITH nearly $200,000 in gold and silver bullion and United States coin locked in her strong room, the *S. S. Colombia* left Mazatlan, Mexico, bound on the last lap of her regular voyage from New York to San Francisco. Wrecked in a gale during the early morning hours of September 13th, she settled on a reef off Point Tosca, buried almost to the base of her funnel in the swells.

When the salvage ship arrived, two days later, it was found that the strong room was submerged and in order to reach the gold the room would have to be blasted with dynamite or opened with torches.

For a week, seas and wind frustrated their plans. Then, in the face of an impending gale, and without again having chance to board the fast-breaking hulk, the salvors were compelled to return, empty-handed, to San Pedro.

After a hasty telephone conversation with the main offices in New York, it was decided that the *S. S. Homer*, once a ship carrying passengers to the *(Continued on page 108)*

FIGHTING THE SEA FOR WRECKED SHIPS

(Continued from page 107)

Yukon gold fields, should be fueled and provisioned for a month's siege. The *Homer* was chosen because of her side hatches through which divers could descend conveniently to their work. Captain John Johnson was sent from Norfolk, Virginia, to direct the operations.

When the *Homer* reached Point Tosca, October 9th, nothing was visible of the *Colombia* but the tips of two of her cargo booms. A hundred-mile hurricane had smashed the doomed ship to the bottom!

Groping through the mass of groaning wreckage, fifty feet down, divers Groves and Lahti found bulkheads and beams scrambled together, steel hull plating torn and crumbled like paper. The stern of the *Colombia* had been drawn 200 feet from the amidships section; the vessel, originally 400 feet long, and having a forty-foot beam, now lay scattered over an area 1,200 feet long and 1,000 feet wide!

Day by day, in constant danger of being crushed or of having their hose or lifeline fouled by breaking plates and beams, the divers searched the debris. Soon they located what had once been the strong room—door missing, sides broken open, the treasure gone! Cutting their way with torches and small charges of dynamite, they finally came upon the gold.

PRYING bars of bullion, each weighing from seventy-five to ninety pounds, from the debris, and sending them up in specially made canvas bags; literally sweeping up gold, silver, and bronze coins with a gigantic improvised "vacuum cleaner," the treasure of the *Colombia* was slowly raised.

Before they abandoned the search, the divers had scraped for treasure all the way down through the fuel tanks to the ocean bed beneath the bottom plating of the ship. By the end of November, more than ninety-seven percent of the bullion and ninety percent of the coins were in the hands of the underwriters who had paid the loss.

Expending thousands of dollars, risking millions of dollars' worth of equipment, and even lives, on a single venture, the salvage company generally gets nothing if it does not "bring home the goods." If salvors spend weeks trying to raise a ship, and then bring up nothing, the company gets not a cent of pay.

If they succeed they are paid an amount depending upon these factors: (1) the dangers from which the property is saved; (2) danger to salvors; (3) value of property salved; (4) value of property risked by salvors; (5) labor, time, skill, expended by salvors; (6) risk run by salvors of not saving property and consequently not being paid.

Despite the strength of modern ships, the well-lighted shores, and radio warnings, the salvor has still about fifteen million dollars' worth of ships and cargoes to save and salvage from the sea each normal year.

TO RECEIVE ATTENTION, every inquiry relating to articles published in POPULAR SCIENCE MONTHLY *must be accompanied by a self-addressed, stamped envelope. It is important that the questions be brief and to the point. Mention the article, the page, and the issue of the magazine to which reference is being made.*

NEW TOOL SPRAYS MOLTEN METAL

(Continued from page 29)

in weight or balance. Inspection of many of them, after the terrific ordeal of firing and passing through targets, showed that the coatings had remained intact.

Completely to commercialize the process, it was necessary to provide means for reaching all kinds of surfaces as well as all kinds of materials. Special nozzles that could be attached to standard spraying guns were devised to reach inaccessible areas. With a rotating nozzle, for example, the interiors of castings, pipes, cylinders, or vessels having small orifices, can be coated. Coatings may be applied to the inside of a pipe, only an inch in diameter, up to twenty feet in length.

Conceived originally as a method of protecting iron and steel from atmospheric corrosion, industrial requirements soon vastly broadened the applications of metal spraying.

FURNACE and grate bars, coated with aluminum and heat treated to produce ferro-aluminum oxide, have proven 300 to 400 times as durable as untreated bars. Mandrels for bottle-making machines, made of the best steel available, generally give only one-half to four hours' service. Sprayed with aluminum and heat treated, these mandrels have given up to *seven weeks'* service.

As sprayed metal does not affect the temper or the chemical nature of the surface upon which it is applied, it has been used as a protective covering where other plating processes could not have been used. During the World War the light shrapnel helmets and the scabbards and sword blades of the German officers were coated with zinc so they would not glisten in the sun. Coatings of lead have been applied to the interior of submarine battery rooms, to guard against acid fumes.

Sprayed metal is now used to replace mechanically worn material, to increase dimensions or weight, to alter shapes and repair mechanical defects, and to develop decorative effects.

Protecting the super-heater tubes of the *Bremen* and the *Europa,* securing the cable joints of the Hudson River bridge from failure by corrosion, creating some of the interior ornamentation of New York's Empire State Building, this comparatively young miracle-process has gained a place among the symbols of the modern world.

FIND MANY METALS IN THE HUMAN BODY

You have silver in your tonsils, titanium in your lungs, and zinc in your liver, while traces of copper, chromium, and tin are scattered throughout your body. Minute quantities of these metallic elements, shown by recent chemical and spectrographic tests to be present in the form of salts or other compounds in all normal men and women, offer a mystery to medical science, according to the American Medical Association.

A generation ago, physiologists dismissed any such small "traces" of elements as accidental and of no particular significance. It is now believed, however, that they may be essential to humal health and growth, despite the fact that their function is still unknown. Latest tests upon plants show that growing wheat and barley perish when zinc is kept from them, and sunflowers raised under similar circumstances fail to produce seed. Experimenters are now eagerly investigating the possibility that animals and human beings may be equally dependent upon "traces" of the metallic elements recently discovered in their bodies. If so, these elements may become recognized as important factors in human diet.

TINY MOTOR TO FILL AIR WITH FLIVVERS

(Continued from page 47)

planes and boats. One of his tiny powerplants, with a bore and stroke of only an inch and a quarter, has flown a huge model plane with a wing span of a dozen feet. In all, scores of different designs have been worked out by Wall in his laboratory. Recently, he brought out a remarkably light one-horsepower motor that weighs complete only a little more than seven pounds.

Many of the parts on such a pygmy motor, such as the magneto coil, would be no larger on a three-horsepower engine than on the one-horsepower one. So, a larger motor, delivering enough power to fly a soaring plane, should weigh hardly more than ten pounds. Complete with its three-foot special propeller and its little one-gallon aluminum fuel tank, it should be developed so as to add to the weight of the plane at most no more than twenty-five pounds.

Without altering the design of present-day soaring ships to any great extent, such a pygmy powerplant could be installed in the nose of the streamlined fuselage. It would answer the question: How small can the motor be? It might even be made detachable, with the pilot's seat sliding forward a few inches to compensate for the change of the center of gravity when the engine was removed for a soaring flight.

THIS miniature motor, which you probably could slip in a brief-case, would keep the plane in level flight and allow it to climb. But probably it would be too small to enable a takeoff from a flat field. The first battle in getting a plane into the air is overcoming the friction of running along the ground and accelerating the machine from a standstill to flying speed. That requires much more than mere flying power, just as in starting an automobile you have to go into low gear, applying the full strength of the engine, to get the car in motion.

The Wright brothers rigged up a falling-weight catapult to shoot their underpowered biplane down a greased rail and aid the engine to get up flying speed. A simple spring catapult, which the operator could wind up and then release from the cockpit of his machine, could easily be devised to give the plane with the midget motor its initial impetus and avoid straining the little engine.

Once the plane is started off at its most effective flying speed, about thirty-three miles an hour, the miniature powerplant should have no trouble in keeping it from slowing down in the air. In the event of a forced landing, a downhill takeoff, with gravity aiding in getting up speed, could be made from a large field.

AFTER a takeoff, the wide-winged sailplane would climb slowly into the sky under its own power. It could continue to fly under its own power, or the little engine could be shut off and the machine ride the rising air currents. When it began to lose altitude, the motor could be "kicked on" and used to fly over to the next column of rising air where soaring would be resumed.

On at least one occasion, a heavy motored monoplane soared for hours with the engine cut off. Over a crescent-shaped ridge of hills on the edge of the Sahara Desert, a number of years ago, a French army pilot, Lieut. Thoret, felt his Hanriot training plane being lifted by upcurrents deflected from the ridge and rising from the hot sands below. He cut off his engine and soared back and forth along the ridge for nearly seven hours.

As the weight added to a modern soaring ship by a three-horsepower motor would be little, such a craft should soar in practically the same upcurrents as will keep a motorless craft of the same size afloat. A trip from San Francisco to Los Angeles, down the Pacific coast, such as W. H. Bowlus proposes to make in his sailplane, could be accomplished easily by a soaring ship with a midget motor to carry it across areas of "dead air" among the mountain ridges.

The English "Wren," running its seven-horsepower engine all the time, covered nearly eighty-seven miles on a gallon of gasoline. A craft, with a three-horsepower motor operating only part of the time, should make as much as 200 miles on a gallon of fuel.

To reduce resistance during soaring, a folding propeller, which mechanical difficulties would make impossible on a larger powerplant, could be fitted to the baby engine. The little foot-and-a-half-long blades could be hinged at the hub and have springs behind them to push them forward as soon as the motor stopped, and centrifugal force no longer held them out. The two blades meeting in front like the hands of a high-diver would reduce air resistance to a minimum.

WHEN the motor began turning again, centrifugal force would pull the blades back to their normal position and hold them there. Such a scheme of eliminating the resistance of a "dead" propeller during soaring flight probably would be simpler than having the blades of variable pitch so they could be turned straight ahead like two knives when they were not revolving.

In the early days of aviation, a dirigible was flown in Germany with a propeller formed by two strips of limp canvas attached to a central hub and having lead weights at the outer ends. When the motor began turning, centrifugal force, acting on the weights, stiffened out the canvas blades. Of course, such screws were inefficient. But the principle that made them work at all, will make possible folding propellers, to reduce resistance on small planes.

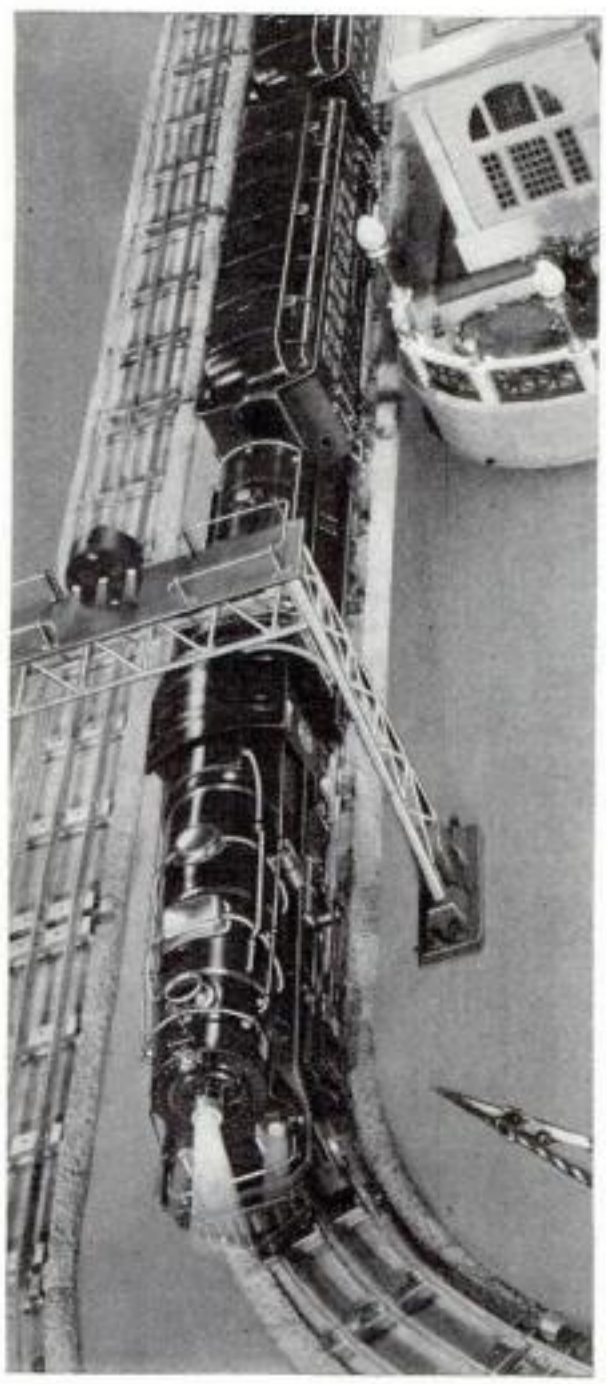
Other than the ones mentioned, few innovations and changes would be necessary to fly a soaring ship with a "vest-pocket" engine. The ordinary one-wheel landing gear at the bottom of the streamlined fuselage could be retained as mounting the motor at the top of the nose of the fuselage would give the propeller more than the foot and a half clearance needed to keep it from hitting the ground.

WHILE the top speed of such a craft would be not much more than 35 miles an hour, landings could be made at such a drifting pace that, in an emergency, the machine might be set down on a housetop with little danger. Like a sailboat with a small auxiliary engine, it would offer wide possibilities for sport. Although a "fair-weather" craft, with insufficient power to battle wind and storms, it would allow, on fair Saturday afternoons, several hours of sky-cruising at little cost. An interesting competition would be to see who could make the most miles on a gallon of gasoline, testing the skill of the pilot in taking advantage of every chance to soar with the engine cut off.

An ocean liner plows through the water at high speed, driven by turbines having thousands of horsepower, while a canal boat plods slowly pulled by a single horse. One has high speed and power, and pays for it; the other travels slowly, but at a minimum of expense. Similarly, an ordinary plane, with its excess power, makes high speeds and quick climbs. A "smallest motor" ship, while never attaining great speeds, would cost comparatively nothing to run. It would fill a now-vacant place in the realm of aerial sport.

Because of the infinite skill and care required to build soaring planes, the initial cost of a midget-motor craft would not be low. But the operating expense, once the plane had been secured, would be negligible.

To fathers who want to be proud of their sons



DO you want your son to be keen-witted, quick-thinking, resourceful—or don't you care? A lot depends on you. These are the years in which your boy's body and brain are forming the habits that will make or break him later on.

Do all you can *now* to keep life from giving him an ugly break. Help him form the most important habit of all, *the habit of thinking things out for himself.* We can help you in this, just as we have helped thousands of other fathers, because Lionel Electric Trains are more than toys. They teach boys how to develop skill with their hands and, above all, skill with their brains. They help boys form the all-important habit of thinking problems out for themselves because they make these problems into a fascinating game. For instance, your boy will not only have the fun of building his railroad and operating it; he will have the opportunity to tackle actual problems of railroad operation such as how to prevent wrecks; how to clear traffic in freight yards; and other fascinating things which give him training in both electricity and mechanics. Incidentally, this year you can buy your boy these sturdy, lasting trains for as little as $5.95.

Give him this help. Clip the coupon below. Take it to your nearest department store, hardware, electrical, toy or sporting goods store. There you can get, *free*, the new 52 page *Lionel Model Railroad Planning Book* that shows you exactly what you and your boy want to know about (1) how to plan and build a model railroad system and (2) what to get to make it true-to-life to the last detail. *Note:* If it is not easy for you to go to a Lionel dealer's store—mail the coupon to us and we will send you this expensive book if you will send 10c to cover handling and mailing costs.

NOTICE TO ALL AUTHORIZED LIONEL DEALERS. *The bearer of this coupon is entitled to receive,* absolutely free, *one copy only of the new 1932 Lionel Model Railroad Planning Book.*

NOTICE TO THE PUBLIC. *If your dealer cannot supply you with a Lionel Railroad Planning Book, or if it is not easy to go to his store, mail this coupon to the LIONEL CORPORATION, Dept. 8, 15 E. 26th St., New York City. We will send you this expensive book if you enclose 10c to cover handling and mailing costs.*

NAME.....

STREET.....

CITY.....*STATE*.....

LIONEL *Electric* TRAINS

Radio and Dynamite Find Earth's Riches

(Continued from page 42)

vibrations created by the motions of the operator in the truck containing photographic and other apparatus, and the vibrations of his small electric motor, it is placed in the ground 300 feet from the vehicle. As a matter of fact, the ear is so sensitive that it is impracticable to operate it at more than one-tenth of its full capacity.

The ear is brought into play mostly in the widely used so-called reflection method of locating oil wells. The other day, Rieber explained to me how this is worked.

Several dynamite charges are buried; those nearby in fairly shallow holes, and the more distant, heavier loads at such a depth that the initial explosions will deliver their force into the earth before blowing off the top.

WHEN, by closing a switch in the instrument truck, the dynamite, buried over a two-mile area, is set off, surface waves travel directly along the earth's upper layers to the ear. At the same instant, other waves shoot down, and are reflected back when they strike layers of hard rock below the surface of the earth. Oddly enough, the more distant explosions reach the receiver more quickly, in proportion to their distance, than the shots near by. This is because the lower, more solid beds permit the waves to travel faster, some of them up to a rate of 20,000 feet per second. By comparing the running time of the surface waves with that of the waves from lower beds, the depth and nature of those beds can be determined.

This ingenious method, developed by Dr. Ludger Mintrop, a German geophysicist, was introduced by him into the United States eight years ago. Mintrop, of course, did not have the benefit of Rieber's ear, and he employed portable seismographs in his work. His technique is adapted particularly to locating flat-lying layers of greater density than the surface layer. It has been used with sensational success in Texas and Louisiana, where the paths of vibrations through the earth often are broken by irregular underground formations.

Sound waves which go straight down into the earth, are employed wherever there are beds of sufficient density to reflect the waves. These shocks are timed much as a clocker times a race horse. As has been explained, experts, by calculating the speed of the waves through the earth, can ascertain not only the composition of the lower layers, but also the depth at which they lie.

After a recent survey, for example, Rieber reported that a body of unusually heavy and solid rock, probably volcanic, lay 2,000 feet below the surface of a California valley, and advised against drilling in that area. All oil-bearing rock is of the sedimentary kind. His theory that it was volcanic was based on the fact that the waves raced through it at a higher speed than is characteristic of sedimentary rocks.

Soft clays and shales transmit waves from 6,000 to 7,000 feet a second; hard shales from 8,000 to 10,000; soft limestone from 12,000 to 14,000 and basalt from 19,000 to 20,000.

His advice was not taken, and a well was drilled. It turned out to be a dry hole.

As a result of the new geophysical methods of prospecting for oil, about 25,000,000 people in the United States today can afford to buy gasoline for their cars. In fact, so many new gushers have been discovered in recent years that the working time in several American oil fields has been curtailed to prevent overproduction.

In Venezuela, Russia, the Argentine, Roumania, Persia, North Germany, the Dutch East Indies—everywhere, in fact, that oil may be found, prospectors with dynamite and marvelous instruments of precision are discovering new fields.

The tremendous importance of the new methods lies in the fact that, with their aid, treasure is unearthed in territories that bear no outward signs of mineral wealth. Most of the areas where surface indications could lead man to oil, already have been drilled. And this applies to other minerals as well. Cars, radios, airplanes, and other articles in daily use become cheaper as prospectors discover new sources of metal supply.

Prominent among the aids of the modern prospector, is the airplane. Today, up in Canada, exploring geologists search from the air for clues to stores of hidden wealth. In a single day of flying, geologists can explore an area they could not cover on foot in months. What can they see from the air? The Kennecott copper mine in Alaska, although not discovered from an airplane, is an answer to that question.

For years men prospecting for gold in Alaska had noted one green peak in a range of mountains, but had passed it by to pursue their hunt along the streams. One day, a bright prospector noticed that the green peak stood above the timber line. That green could not be vegetation, and he determined to find out what it was. Climbing to the summit, he found the green was the familiar verdegris of oxidized copper. He had climbed a mountain of copper! It proved to be be one of the richest deposits in the world.

Whenever a flying prospector sees an exposed rock surface that invites closer inspection, he marks the place on his map. Afterwards, detail parties make their way in canoes and afoot through the wilderness until they find that spot. Then, by trenching and the more modern methods, they make a systematic survey of the region.

Year by year, wonderful new instruments are added to the prospector's tool-kit. Nevertheless, the old-fashioned rule-of-thumb methods still are used by geologists who are sent into the wilderness to find buried treasure. After all, the prospector is a kind of detective, and some of his best work is still done by reasoning and deduction.

How simply an old mine was rediscovered was told to me recently by Professor Charles P. Berkey, head of the department of geology in Columbia University, New York. Dr. Berkey was a member of the expedition that Dr. Roy Chapman Andrews led into the Gobi desert for the American Museum of Natural History.

In a Mongolian village, a woman showed Berkey a substance used as medicine. She had watched the geologists chipping rocks and assumed they would be interested in anything of the sort. The bit she gave Berkey was yellowish in color and the size of the end-joint of your finger. Many queer nostrums are used in China, but nothing that could have awakened keener interest in a geologist. Her piece of "medicine" was copper ore!

The woman said the piece of ore had been given her by a Buddhist priest, who lived in a lamasery, or monastery, some miles away. Several members of the party set out to find the priest and learn the source of the copper.

As they came in sight of the monastery, they saw several low hills. The color of those hills, bare of vegetation, told the geologists they did not need the priest's assistance. Driving directly to the hills they found—a mine.

It had been worked thousands of years ago, in the Bronze Age. The ancients who had extracted the ore from that deposit naturally had worked with the most primitive tools, but they worked thoroughly. All that remained were two yawning pits in the earth. One was more than 700 feet across, and each was so deep that its bottom was covered with water, and this, mind you, in the desert!

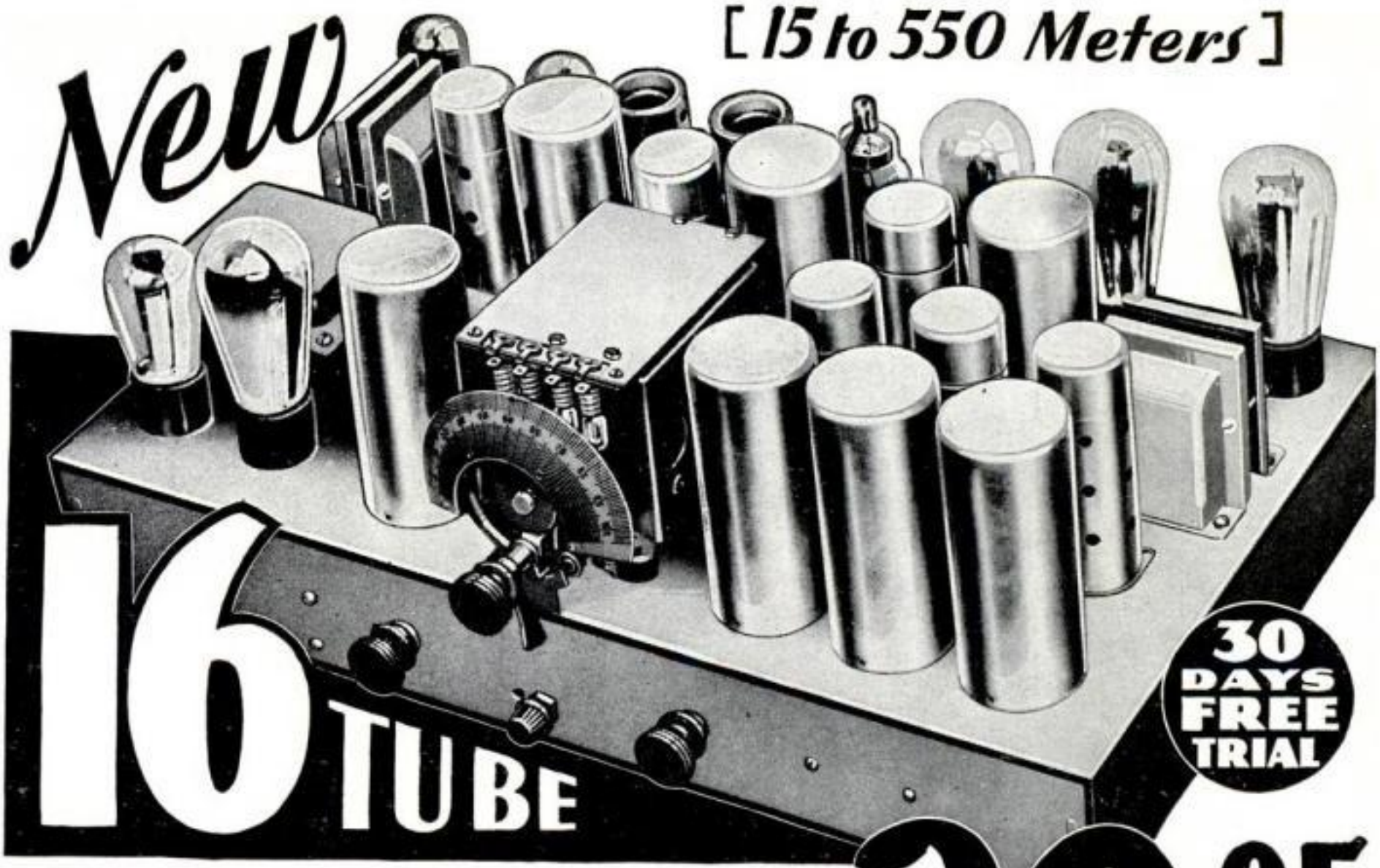
The emerald mines of Bogota we owe to the Incas of Peru. When Pizarro began the ruthless march that ended with the subjugation of those highly civilized Indians, his greed was aroused by the discovery of sacred images made of gold and jeweled with emeralds. The town where he first found those idols he called Esmeralda, but it was years and years before those jewel eyes of Indian gods were traced to the hills of Bogota.

Today, South American prospectors are searching feverishly to rediscover stores of riches described in history as the lost mines of the Indians. With the latest geophysical methods at their command, they stand a fair chance to succeed.

Wonderful Birds Are the Pelicans

This remarkable picture of the mammoth billed birds, made by a British photographer, is an evidence of unconscious posing by the birds. So rare is the composition that studied effort by the photographer could have done little more. An article of interest to all who use a camera will be found on page 82 of this issue

New [15 to 550 Meters]



16 TUBE ALL-WAVE RADIO

30 DAYS FREE TRIAL

Only $39.95

Completely Assembled *with* Large Dual Speakers

World Wide Reception

may be yours when you own this sensational new Midwest 16-tube ALL-WAVE set with a tuning range of 15 to 550 meters. Hear standard U. S. broadcasts from coast to coast, listen to amateurs, police calls, airplane conversations, and, when conditions are favorable, short-wave broadcasts from England, Germany, France, Italy, South America, Australia, and other stations all over the world. You get the WHOLE WORLD OF RADIO when you get this new 16-tube Midwest—and you buy it at an amazingly low price direct from the big Midwest factory, on easy payments if you wish. No middlemen's profits to pay when you buy the Midwest way.

Don't be satisfied with less than a 16-tube Midwest ALL-WAVE set. A receiver covering only the regular broadcast waves is only half a set. Improvements in short-wave programs and receivers have made ordinary broadcast sets obsolete. The Midwest All-Wave gives you everything that's good in radio, both at home and from abroad—and all in one single dial set with perfect tone and volume control and the marvelous new color-lite tuning and STAT-OMIT.

ALL THE NEW 1933 FEATURES

- Stat-Omit Tuning Silencer . . . .
- Class "B" Amplification . . . .
- Color-Lite Wave Band Selector . . . .
- Acoustically Matched Dual Speakers . .
- Full Band Automatic Volume Control
- Dual Power, Two separate transformers
- Dual Ratio Dial . . . .
- One Complete Chassis . . . .
- Complete Scientific Shielding . . . .
- 18 Tuned Circuits, 9 in cascade . . . .
- 15 to 550 Meter Tuning Range . . . .
- Image Frequency Suppressor . . . .
- Fractional Microvolt Sensitivity . . . .
- Full-Floating Variable Condenser . . .
- Absolutely Faithful Tone Reproduction
- Positive Tone Control . . . .
- Thermal Safety Fuse . . . .
- Duplex Duo-Diode Detection . . . .
- New Type Tubes . .
- Low Operating Cost

TERMS AS LOW AS $5 DOWN

Read this letter!

"During the past week I logged the following: FYA Pontoise, France; GBK Bugby, England; HVJ Vatican City, Italy; XDA Mexico City; VK2ME Sydney, Australia; VE9GW Bowmanville, Canada; 12Ro, Rome, Italy; G5SW Chelmsford, England; CGA and VE9DR Drummondville, Canada. Also picked up many amateur and airport stations from all over United States. Numerous ship, shore and transatlantic phones from both sides and an Hawaiian Test Station came in clear and sharp. Several Spanish and German speaking stations have also been received but not yet identified. Have received every broadcast from FYA, morning and afternoon, for over a week with wonderful tone and volume. The Midwest set is certainly one to be proud of."
—Wm. S. Teter, Winterpark, Florida.

COMPLETE LINE OF CONSOLES
The big new Midwest catalog shows gorgeous line of artistic consoles in the new six-leg designs. Mail the coupon now. Get all the facts.

Don't buy any radio until you get the big new Midwest catalog. Just sign and mail the coupon or send your name and address on a postal—NOW!

Deal Direct with Factory!
SAVE UP TO 50%

Midwest sweeps aside the costly old-fashioned way of selling through distributors and dealers. You buy direct from the Midwest factory with just one small profit added. You save all of the middlemen's profits.

Investigate! Mail the coupon. Get the Midwest catalog. Learn the facts about Midwest 9, 12 and 16-tube ALL-WAVE sets—also Battery sets and amazing new Radio Phonograph. Learn about our sensationally low factory prices, easy payment plan and positive guarantee of satisfaction or money back. Get a bigger, better, more powerful, better toned radio—at a positive saving of 30% to 50%!

RUSH THIS COUPON FOR AMAZING FREE TRIAL OFFER AND BIG BEAUTIFUL CATALOG

User Agents Easy EXTRA MONEY! Check here for details. ☐

Midwest Radio Corp.,
Dept. 126,
Cincinnati, Ohio

Without obligation on my part send me your new 1933 catalog, and complete details of your liberal 30-day free trial offer. This is NOT an order.

NAME .....

ADDRESS .....

TOWN .....

STATE .....

MIDWEST RADIO CORP.

Dept. 126 **(Est. 1920)** **CINCINNATI, OHIO**

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

THE DARK AND BLOODY GROUND

"Nature in the Raw"—as portrayed by N. C. Wyeth, noted painter of the American Indian . . . inspired by the fierce cruelty of the savages, whose knives and tomahawks caused the story of the Pioneer West to be written in blood.

—and raw tobaccos have no place in cigarettes

They are *not* present in Luckies
. . . the *mildest* cigarette
you ever smoked

WE buy the finest, the very finest tobaccos in all the world—but that does not explain why folks everywhere regard Lucky Strike as the mildest cigarette. The fact is, we never overlook the truth that "Nature in the Raw is Seldom Mild"—so these fine tobaccos, after proper aging and mellowing, are then given the benefit of that Lucky Strike purifying process, described by the words—"It's toasted". That's why folks in every city, town and hamlet say that Luckies are such mild cigarettes.

"It's toasted"

That package of mild Luckies

"If a man write a better book, preach a better sermon, or make a better mouse-trap than his neighbor, tho he build his house in the woods, the world will make a beaten path to his door."—RALPH WALDO EMERSON.

Does not this explain the world-wide acceptance and approval of Lucky Strike?